

**SCIENTIFIC ADVISORY PANEL (SAP)**

**OPEN MEETING**

**OCTOBER 25, 2001**

**VOLUME I**

Located at: Sheraton Crystal City Hotel  
1800 Jefferson Davis Highway  
Arlington, VA 22202

Reported by: Frances M. Freeman

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## **C O N T E N T S**

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1 DR. ROBERTS: (In progress) -- Scientific Advisory panel.

2 As our first agenda item, I would like to ask Ms. Olga Odiott, our  
3 designated federal official for this meeting, for her instructions  
4 and announcements.

5 MS. ODIOTT: Thank you, Dr. Roberts. Once again, I  
6 would like to welcome everybody to this important meeting of the  
7 FIFRA Scientific Advisory Panel concerning CCA-treated wood.

8 For the benefit of those who are joining us today for  
9 the first time, this meeting is being conducted under the  
10 provisions of the Federal Advisory Committee Act, also known as  
11 FACA.

12 All applicable ethic requirements of the federal  
13 conflict of interest laws have been met by the members of this  
14 panel.

15 At the conclusion of the meeting, the panel will  
16 prepare a report as a response to the questions posed by the  
17 agency. The report will serve as meeting minutes and we  
18 anticipate to have that report ready within 30 days.

19 All background materials and other documents related  
20 to this meeting are available from the OPP docket and also from  
21 the EPA web site. The contact information for both the docket and

1 the web site is listed at the top of your agenda.

2 During the past two days, we have had very informative  
3 presentations. The discussions have been very productive and key  
4 to the issues that this SAP panel has been asked to address.

5 I want to thank the panel for the enthusiasm and the  
6 dedication demonstrated during the past two very long days.

7 We have a full agenda today, and that's probably an  
8 underestimation. But the agency is looking forward to the panel's  
9 feedback on those issues presented by the 14 questions that we  
10 have before us today.

11 DR. ROBERTS: Thank you, Olga. We also need to  
12 introduce the panel. Let me begin, and we'll go around the table.

13 I am Steve Roberts. I'm from the University of  
14 Florida.

15 Dr. Freeman?

16 DR. FREEMAN: . Natalie Freeman from Robert Wood  
17 Johnson Medical School and the Environmental and Occupational  
18 Health Sciences Institute.

19 DR. KOSNETT: Michael Kosnett, University of  
20 Colorado Health Sciences Center.

21 DR. KISSEL: John Kissel, University of Washington.

1 DR. BRUCKNER: Jim Bruckner, University of  
2 Georgia.

3 DR. GORDON: Terri Gordon, NYU.

4 DR. LEES: Peter Lees, Johns Hopkins University.  
5 Liedy.

6 DR. LEIDY: Ross Leidy, North Carolina State  
7 University.

8 DR. SOLO-GABRIELE: Helena Solo-Gabriele,  
9 University of Miami.

10 DR. BATES: Michael Bates, University of California  
11 at Berkeley.

12 DR. STYBLO: Miroslav Styblo, UNC-Chapel Hill.

13 DR. STEINBERG: J.J. Steinberg, Albert Einstein  
14 College of Medicine.

15 DR. CHOU: Karen Chou, Michigan State University.

16 DR. MUSHAK: Paul Mushak, PB Associates.

17 DR. FRANCOIS: Rony Francois, University of South  
18 Florida, College of Public Health.

19 DR. SMITH: Andrew Smith, State of Maine, Bureau of  
20 Health, Department of Human Services.

21 DR. SHI: Xianglin Shi, NIOSH.

1 DR. MORRY: Dave Morry, California Environmental  
2 Protection Agency.

3 MR. CLEWELL: Harvey Clewell, Environ.

4 DR. ADGATE: John Adgate, University of Minnesota,  
5 School of Public Health.

6 DR. WARGO: John Wargo, Yale University.

7 DR. HEERINGA: Steve Heeringa, University of  
8 Michigan.

9 DR. ROBERTS: Thank you, panel.

10 We have quite a bit of work ahead of us today. We  
11 have 14 questions left on the agenda and, if you do a little bit of  
12 math, that means it averages about 30 minutes of discussion per  
13 question, if we're going to get through by a reasonable hour and  
14 leave some time for discussion of other questions.

15 As we go through the questions today, I'm going to  
16 have to insist that the comments be directed specifically to the  
17 questions.

18 As I told the panel before, there will be the opportunity  
19 to comment on other scientific issues not covered in the questions  
20 at the end. But the only way we're going to have time to do that  
21 and do that well is if our comments are focused and concise and

1 efficient as we go through the discussion.

2                   So we really need everybody to think about your  
3 points. By all means, I want every panel member who has an  
4 opinion, give them the opportunity to express it. But please  
5 express it as concisely as possible.

6                   If you get off on a tangent, you are really just wasting  
7 your time and the rest of the panel's time because there is not  
8 going to be any way to get that information into the panel'  
9 response to the question. It's just lost information.

10                  Also, I would like the panel members to confine their  
11 comments to scientific issues. There are avenues for input to the  
12 agency on policy issues, and I would encourage you, if you feel  
13 strongly about a policy issue, to explore and use those avenues,  
14 but we're here today to provide the agency with scientific input on  
15 some technical matters and questions they have brought before us.

16                  Now, we finished our discussion of question 1 kind of  
17 late, after a long day yesterday.

18                  I would like to provide the opportunity, if there are any  
19 panel members who, upon further reflection last night, have a  
20 different opinion that they would like to express or renew or  
21 modify their opinion, to give them the opportunity to do so. I

1 don't expect, nor frankly do I want to rehash all of the issues that  
2 we talked about in issue 1 last night, but I do think that it's  
3 important to give panel members the opportunity to, after a night's  
4 sleep, to make any comments they might want to add to the record  
5 on question number 1.

6 So let's begin with that. And let me ask if there is  
7 anyone.

8 Dr. Kosnett?

9 DR. KOSNETT: Thank you, Mr. Chairman, for the  
10 opportunity to finish that issue briefly, I hope.

11 Basically, I just want to make clear for the record I  
12 think an important opinion regarding the discussion about the  
13 safety margin yesterday.

14 There was -- I was in agreement with the LOAEL of  
15 .05, but I have serious concerns about this 30-fold safety factor  
16 both with respect to how it was derived and the interpretation as to  
17 what it might mean.

18 ATSDR and EPA guidance, in the document developed  
19 by Dr. Benson, recommended a 10-fold safety factor in  
20 establishing what ATSDR calls a minimum risk level or MFL of  
21 .005 milligrams per kilograms per day. Approximately a 10-fold



1 safety factor or a 10-fold safety factor from the .05.

2 And I think the 30-fold safety margin is just not  
3 supported by the data. Essentially, I think we have to subject it to  
4 a bit of a reality test. A 30-fold safety margin would essentially  
5 establish a value of about .002 milligrams per kilogram per day.

6 And in the case of a 15-kilogram three-year-old, that's  
7 essentially saying that 30 micrograms a day should be flagged as a  
8 level of concern for an exposure as brief as six months.

9 In my experience as a physician and toxicologist who  
10 has been interested in the clinical toxicology of arsenic for almost  
11 20 years, there is no basis in my experience or any published  
12 material that would suggest that anyone needs to be concerned  
13 about having acute non-cancer effects within six months for  
14 exposure of a three-year-old to 30 micrograms per kilogram per  
15 day.

16 And in fact, if one considers the fact that a  
17 three-year-old consumes approximately one liter of drinking water  
18 a day and that the United States maximum contaminant level for  
19 arsenic in drinking water has been 50 micrograms per liter for  
20 approximately 60 years, and there are numerous communities in  
21 the country that have had water that is in the range of up to 50 up

1 to that time, we have no experience or basis on that record to be  
2 concerned about acute health effects.

3 That essentially, for example, would, since the  
4 background level of arsenic in the diet is 5 micrograms a day for a  
5 three-year-old, inorganic, that's essentially saying that we would  
6 be concerned of a level of 25 micrograms per liter in the water,  
7 adding 25 micrograms per liter in the water, one liter a day, to the  
8 5 background to get 30 micrograms per day, which would be 2  
9 micrograms per kilogram, which is the acute hazardous level  
10 which has been suggested to flag for concern.

11 That just does not meet our experience. It does not  
12 meet the studies that have been actually done on communities.  
13 Granted, they are not necessarily large or exhaustive studies, but  
14 there have been studies done on communities with levels up to the  
15 range of about 200 micrograms per liter in this country which have  
16 looked for non-cancer effects, studies by Chrise (ph) in Alaska,  
17 Southwick in Utah, Harrington in Alaska. And they have not found  
18 in those communities any basis for being concerned at a level of 2  
19 micrograms per kilogram per day for up to six months.

20 So I just want to go on the record as saying that I could  
21 not support that and I don't think it's advisable. I would concur

1 with ATSDR and EPA's guidance with a 10-fold margin, which -- I  
2 could concur with it being justified on the basis of the serious  
3 nature of the LOAEL and the possibility of inter-individual  
4 variability.

5                   And just to complete my comments, I just want to tell  
6 you how I think that level ultimately should be interpreted. As it  
7 states in Dr. Benson's document, that should be used as a screening  
8 level to identify contaminants for further evaluation in public  
9 health assessments and to identify potential health effects that  
10 may be of concern at hazardous waste sites.

11                   It's important to note that MRLs are not intended to  
12 define cleanup or action levels. They are guidance values, below  
13 which non-cancer adverse effects are unlikely, and below levels  
14 that might cause adverse health effects in the people most  
15 sensitive to such chemical-induced effects.

16                   Exposure to a level above the MRL or above this level,  
17 .005, does not mean that adverse health effects will occur. MRLs  
18 are intended only to serve as a screening tool to help public health  
19 professionals decide when a more detailed toxicological  
20 evaluation is necessary.

21                   They may also be viewed as a mechanism to identify

1 those hazardous waste sites that are not expected to cause adverse  
2 health effects in an exposed population.

3 DR. ROBERTS: Thank you, Dr. Kosnett. So basically  
4 you concur with a LOAEL of .05, but would recommend a margin  
5 of exposure of 10 rather than 30 as we discussed.

6 Any other comments?

7 Dr. Clewell, then Dr. Mushak.

8 DR. CLEWELL: Thanks. Actually, that's very  
9 informative.

10 I think what you are basically indicating is that it's a  
11 very steep dose response for arsenic in that you can have effects at  
12 .05, but are you fairly comfortable there wouldn't be at .02, and I  
13 follow your logic.

14 I think it's important to know that what EPA was --  
15 EPA did not come up with the same number as ATSDR. The MRL  
16 is .005, but EPA was suggesting using 10 for variability in  
17 addition to the 10 for LOAEL. So they would be at a really low  
18 number, .0005. So -- part of that, I'm sure, being due to a kind of a  
19 difference in philosophy concerning an MRL versus the number  
20 that EPA was trying to come up with.

21 And I have to say I don't feel I have the precision to

1 say whether 30 versus 10 is better, and I actually bow to your  
2 experience in terms of the likelihood of effects in children. But I  
3 hope this doesn't mean we have to try to refine the consensus.

4 DR. ROBERTS: No. I think, basically, unless people  
5 modify their conclusions from yesterday, they would stand.

6 Dr. Mushak?

7 DR. MUSHAK: Mike, I have a problem with your logic  
8 because yesterday you made it clear for the record that you were  
9 concerned about the proximity of those effects that Mizuta  
10 reported to very serious effects, especially to cardiovascular. And  
11 I think you were comfortable with a 10-fold for a LOAEL to a  
12 NOAEL.

13 So how do you stratify out an overall 10? If you are  
14 comfortable with a 10 for LOAEL to NOAEL, presumably you  
15 don't allow any uncertainty for children versus -- in intra-human  
16 variabilities. I mean, how are you stratifying this 10?

17 DR. KOSNETT: I would think the 10 would encompass  
18 both factors.

19 DR. MUSHAK: But you are already strongly feeling  
20 about this -- are you revising your sense of a LOAEL to a NOAEL?

21 DR. KOSNETT: I think that --

1 DR. MUSHAK: I mean, you can't have it both ways. If  
2 you say you are comfortable with a 10 for a LOAEL to a NOAEL,  
3 then you are saying you have no basis or no sense that there is any  
4 intra-individual variation that comes into the equation.

5 DR. KOSNETT: The 10-fold factor that I would  
6 endorse, which concurs with what ATSDR came up with in coming  
7 up with the MRL, encompasses both the seriousness of the effects  
8 and, in my opinion, the capacity for intra-individual variability.

9 DR. ROBERTS: Dr. Smith?

10 DR. SMITH: I would just like to ask a question of  
11 Dr. Kosnett as well, because I understand what you are arguing is  
12 that basically you are posing a reality test in your experience as a  
13 clinician. This doesn't seem to pass a reality test.

14 As a clinician, which I am not, I would like to ask you  
15 the question of, do you have any concerns that there could be  
16 subtle effects that would not be obvious to a clinician that would  
17 justify the 30-fold?

18 Do you have any worries about there could be more  
19 subtle effects that might not be apparent or is that not of concern  
20 to you, that you feel that, with the existing database and your  
21 experience as a clinician, that you know if there was something

1       there, it really should have manifested itself, given what I agree  
2       with you is unquestionably substantial exposure for some  
3       individuals at these levels?

4                   DR. KOSNETT: I just think, based on our experience  
5       and knowledge, that the 10-fold factor for up to a six-month period  
6       would be a sufficient margin of safety.

7                   DR. ROBERTS: Dr. Bruckner.

8                   DR. BRUCKNER: So I understand what you are  
9       saying, you are advocating the 10-fold, then, from a LOAEL to a  
10      NOAEL. What are you advocating beyond that for intra or for  
11      childhood --

12                  DR. KOSNETT: I want to just say I agree with 10,  
13      combining all the concerns, both the seriousness and the  
14      variability.

15                  DR. ROBERTS: I suppose you could be two factors of  
16      three, I guess. We're all a little -- which is, frankly, a way to get  
17      there. I think we're all probably a little guilty about describing  
18      exactly how we got to the margin of exposure we're most  
19      comfortable with.

20                  DR. KOSNETT: And people can look at Bob Benson's  
21      document and note that that's what ATSDR recommends.

1 DR. ROBERTS: So you are basically comfortable with  
2 their rationale?

3 DR. KOSNETT: Yes.

4 DR. ROBERTS: Dr. Steinberg?

5 DR. STEINBERG: Just responding also, as a clinician,  
6 as a senior attending in a very large New York hospital, clearly I  
7 think we don't know, and I think there is a large gap of  
8 information. I think there is no -- there is certainly no attending  
9 clinician that can tell me that many of the subtle effects that one  
10 could see neurologically, in neurologic examinations, attention  
11 deficit or learning disabilities, whether any of this could be  
12 related to lead or metals or arsenic or other things.

13 I think it's this neurotoxicology -- I think it's this  
14 neurodevelopmental gap that urges us to be very, very, very  
15 careful.

16 The second reason to be very careful is we clearly don't  
17 know why many cancers are going up, some cancers are going  
18 down. We don't understand this. We now have an insight and a  
19 window and a mechanism of action related to arsenic that also  
20 forces us to be very cautious.

21 Good Science is urging us here.



1 DR. KOSNETT: But we're not addressing cancer risks.

2 DR. SMITH: The first question clearly answered  
3 neurotoxicology, and I don't want to dismiss cancer risks, either.

4 DR. ROBERTS: Would anyone else like to weigh in or  
5 modify their opinion in response to the discussion that we've had  
6 today?

7 Dr. Ginsberg?

8 DR. GINSBERG: I think really appreciate  
9 Dr. Kosnett's viewpoint from the clinical standpoint and taking a  
10 look at the studies, which -- he has looked at the epidemiology  
11 database much closer than I have.

12 I guess my concern is that endemic nature of arsenic  
13 exposure in children in any given population may be, as Dr. Smith  
14 was suggesting, difficult to tease out, in effect, a true, quote,  
15 unexposed cohort. So I am concerned that we don't really have the  
16 right control population to completely evaluate low dose effects.

17 And given that we were searching for a NOAEL study  
18 and we felt uncomfortable yesterday, or at least some of us did -- I  
19 think Dr. Roberts said he was uncomfortable with the definition of  
20 that one study as being a NOAEL for all effects -- and that we are  
21 basing things on a LOAEL, when you are dealing with a LOAEL,

1     you don't quite know what the NOAEL is because you don't know  
2     how low you have to go to really define the clear NOAEL. And  
3     given the uncertainties in epidemiology studies about a true  
4     unexposed group, I would just stick with my 30-fold factor.

5                     DR. ROBERTS: Has anyone changed their opinion  
6     from yesterday?

7                     Dr. Smith?

8                     DR. SMITH: I guess, for the record, I never voiced my  
9     opinion yesterday.

10                    DR. ROBERTS: Then you have the opportunity to  
11    weigh in now.

12                    DR. SMITH: I am comfortable with getting to the 30X  
13    uncertainty factor using the 10 and 3, as we've described. But I am  
14    unsettled by Dr. Kosnett's observations. But, nevertheless, I still  
15    feel comfortable with a 30-fold uncertainty factor as long as we  
16    recognized it's being interpreted and used in the typical we use  
17    RFDs for short-term exposure, that being a negligible risk of any  
18    deleterious effect from that sort of exposure window, and that we  
19    don't anticipate any sort of necessary effect immediately above  
20    that level.

21                    DR. ROBERTS: Dr. Mushak?

1 DR. MUSHAK: I'm comfortable with a 30 factor. I  
2 think, Mike, that a lot of the absence studies that show subacute,  
3 subchronic effects have been kind of dealt with simply on the basis  
4 of sample size to show these effects. I mean, Andelman (ph) and  
5 his co workers at Pittsburgh addressed both cancer issues and, I  
6 think, non-cancer issues. Small populations make it difficult to  
7 see these effects.

8 So, you know, absence of evidence is not evidence of  
9 absence.

10 DR. ROBERTS: Anyone else want to weigh in on this?  
11 Hearing no other comments -- Dr. Bates?

12 DR. BATES: This is more of a question. Perhaps it  
13 should be directed to the EPA. But I just wanted what are the  
14 practical implications of setting this level?

15 I understand and I sympathize with what Michael  
16 Kosnett is saying, although, in toxicological principles, I kind of  
17 go along with the 30-fold margin. But there seems to be a bit of a  
18 conundrum here, almost a conflict between the level which we are  
19 proposing and possible practical implications. But maybe that's  
20 not the case. And I'm just wondering whether EPA could tell us a  
21 bit more about what the implications are.

1 DR. EDWARDS: Because we haven't actually  
2 generated risk numbers yet, it's difficult to say exactly what the  
3 implications would be. And it partly will depend upon what the  
4 panel recommends with respect to deterministic versus  
5 probabilistic type assessments for these short-term and  
6 immediate-term exposures. But, obviously, I think you understand  
7 that the lower the value is, the more children will appear to be at  
8 risk in our estimates when we do that.

9 And if it's a deterministic estimate, it could be used  
10 more like a -- you know, almost like a yes/no trigger that's  
11 unlikely to happen because we do discuss uncertainties. But you  
12 see what I mean.

13 DR. ROBERTS: Dr. Hopenhayn-Rich?

14 DR. HOPENHAYN-RICH: I want to just voice my  
15 opinion supporting what Dr. Bates says or maybe just expanding it  
16 a little bit or clarifying it, that I am not sure either of the practical  
17 implications of setting a safety limit for CCA exposure for six  
18 months or less because I can't imagine children being exposed to  
19 playgrounds for only that limited amount of time.

20 DR. ROBERTS: It is kind of a different question. And  
21 maybe not to answer for the agency, but as Dr. Kosnett pointed out

1 in his reading from the ATSDR, when you exceed this, it doesn't  
2 necessarily mean that there are health effects, but what it does is it  
3 triggers a closer examination of the situation.

4 Alternatively, if the exposures are less than that, it's  
5 concluded that there is no significant probability of any harm.

6 Dr. Benson, did I state that reasonably correctly.

7 DR. BENSON: Yes. But let me answer the question  
8 that Dr. Bates posed about the practical implications. In region 8,  
9 if you take the value that you derived yesterday in a residential  
10 scenario for a 15-kilogram child, every residential site in  
11 metropolitan Denver and probably most cities in region 8 are  
12 acutely poisonous to that child.

13 And all the way from Denver to Kansas north to  
14 Canada.

15 DR. ROBERTS: Dr. Vu.

16 DR. VU: I just wanted to clarify -- to add also what  
17 Dr. Benson and Dr. Edwards explained. The margin of exposure  
18 concept would help the agency to determine which kind of  
19 exposure scenario would provide more risk than others, and then  
20 make a judgment with regard to the use and whatever. So it's not  
21 necessarily a finite thing, as Dr. Edwards explained.

1                   So if we're going to compare different exposure  
2   scenarios, playground setting, what kind of risk might be  
3   associated long-term, short-term, whatever -- and those are things  
4   that the agency will consider when we are going to assemble all  
5   the information and develop a risk assessment.

6                   DR. ROBERTS: Dr. Smith?

7                   DR. SMITH: I'm not going to go there.

8                   DR. ROBERTS: Thank you.

9                   Dr. Clewell?

10                  DR. CLEWELL: I am. I feel like I just slid down a  
11   slippery slope while somebody was holding my hand saying, it's  
12   okay, when you get to the bottom you will feel just fine.

13                  So what you are telling me now is that we're falling  
14   into the same trap that the NAS -- or was it the SAB? The ones  
15   who said that there were so many hundreds of thousands of  
16   children that were probably already affected by methyl mercury.  
17   You know, I don't want to say that all of the children in Denver  
18   are, you know, acutely intoxicated.

19                  This is a fairly common problem, actually -- or a not  
20   uncommon problem in risk assessment, that what seemed like very  
21   reasonable uncertainty factors put you in a place where you're

1     either below the minimum essential daily requirement or in a  
2     region where you consider it to be fairly ludicrous that you would  
3     suggest that there be health effects, and I'm beginning to see the  
4     point that Dr. Kosnett was trying to make.

5             Unfortunately, these numbers can be used as bible  
6     gospel, touted in the media, and the next thing you know is Denver  
7     papers are saying that all of our children are -- so I think one of  
8     the things we may have not fully considered is the fact we're not  
9     just asking how much can a child be exposed to by a playground,  
10    because people will be folding in the dietary and drinking water  
11    exposures. And dietary being 5 or so and drinking water, in some  
12    places, being 20 or so, that doesn't leave much room.

13            So I'm just uncomfortable. I don't know what the  
14    solution is, but I have a great deal of discomfort with someone  
15    taking a number that I agreed with and then coming to conclusions  
16    that I would very seriously disagree with. We scare people enough  
17    with things that aren't really going to harm them.

18            DR. ROBERTS: Dr. Benson, let me just ask you to -- I  
19    just was doing a quick math in my head. I think this number would  
20    correspond to about 100 parts per million in soil. Is most of  
21    Denver over 100?

1 DR. BENSON: Typical backgrounds in region 8 vary  
2 between maybe 5 to 20 milligrams per kilogram soil. Sometimes  
3 less, sometimes more.

4 DR. ROBERTS: Well, I was going to say that -- just  
5 kind of running the numbers quickly in my head, the number that  
6 we had sort of settled on with -- some folks thought the 30 margin  
7 of exposure would correspond, I believe, to about 100 parts per  
8 million in soil.

9 DR. CLEWELL: Are you subtracting drinking water  
10 and food exposure?

11 DR. ROBERTS: No. I'm just basing it on a straight  
12 proportion. I know what the number is for the chronic reference  
13 dose, and I'm just using a multiplier for this reference.

14 So I think we ought to think about those kinds of  
15 calculations and implications, but unfortunately, I'm not sure we  
16 have time to do that this morning.

17 DR. GINSBERG: This is a good segue into our next  
18 question. Were you thinking in terms of a relative bioavailability  
19 of arsenic in soil? Because I don't know if Dr. Benson uses one of  
20 50 percent, 25 percent or whatever when you did your thought  
21 process about Denver in K.C.'s soil -- and I don't know if you



1 factored that in, but I know that it's fairly new in the risk  
2 assessment thinking about arsenic in soil.

3 DR. ROBERTS: I did not, but I don't know that  
4 we're -- rather than segue into number 2, I want to get closure on  
5 number 1 very soon.

6 Dr. Solo-Gabriele?

7 DR. SOLO-GABRIELE: I just wanted to follow up  
8 with what Dr. Ginsberg had said. That's what I had in mind was,  
9 even though you have arsenic in soil, is it at all available for  
10 consumption?

11 DR. BENSON: The calculation that I did last night  
12 included a relative bioavailability of 50 percent, which is the  
13 measured value in the site in metropolitan Denver from several  
14 hundred yards. Well, it was a composite sample.

15 DR. ROBERTS: Dr. Smith?

16 DR. SMITH: I don't think we really need to even get  
17 into that debate because there are plenty of people with exposures  
18 above that from drinking water, you know, for Dr. Kosnett to make  
19 his point. So I really think the fundamental issue is just how do  
20 you want to deal with this reality check he is posing to us?

21 And the real question is whether or not that reality

1 check is sufficient to cause anyone to want to move from the 30X  
2 that we have already discussed.

3 DR. ROBERTS: Dr. Chou?

4 DR. CHOU: I think we're facing an unusual decision  
5 here because in the normal practice of risk assessment, we look at  
6 the scientific data, then we do the regular safety factor practice,  
7 and that's what we did last night, and we decided to use 30. And  
8 then the reality check is a very different issue than many of us  
9 never faced before.

10 The question I ask myself is, just because there is more  
11 arsenic out there in the food or in the drinking water, are we going  
12 to make a different scientific decision? And that's why I what I  
13 have been struggling with.

14 I think this thing becomes sort of like a policy or a  
15 paradigm, risk assessment paradigm issue. You know, are we  
16 going to switch to a regular practice paradigm for arsenic?

17 That's the question I ask myself.

18 DR. ROBERTS: Let me ask this. Let me post to it the  
19 panel this way.

20 We have had some discussion on this issue this  
21 morning. The question is, is a LOAEL of .05 reasonable and a

1 reasonable point upon which to base margin of exposure analysis,  
2 and what would your margin of exposure be.

3 Has anyone heard anything that would cause them to  
4 either now make a decision that they hadn't made before or to  
5 change their decision?

6 MR. CLEWELL: Well, I would like to jump over onto  
7 the 10 side.

8 DR. ROBERTS: Okay. That's fine.

9 Dr. Mushak?

10 DR. MUSHAK: I think that, before we look at this  
11 issue of whether minds are changed or not, I think reality checks  
12 are really a separate issue, and we're at the case that we then factor  
13 in reality checks. We're back to where the NAS was with reality  
14 checks for how much internal and systemic cancers we should have  
15 with drinking water.

16 The fact remains that you can always do site-specific  
17 or area-specific reality checks that tend to contradict a risk  
18 assessment model.

19 And this is no different than what the academy has  
20 been wrestling with with the U.S. picture for arsenic-associated  
21 cancers.

1                   So I think that's a separate issue. There are separate  
2 conferences that could probably be held on that, and I think that  
3 that ought not to color people's judgment. This hopping of some  
4 people all over the place with safety margins I think is a bit  
5 unsettling because I'm not quite clear what the basis of that is.

6                   DR. ROBERTS: I really just want comments from  
7 folks -- not on the philosophical issues, but have we sufficiently --  
8 have we had enough discussion that we can put together some input  
9 on the specific question, number 1?

10                  DR. SMITH: For the record, I would like to say I  
11 remain in the 30X camp. However, I would like to strongly  
12 encourage the agency to attempt in any way they can to follow up  
13 on Dr. Kosnett's concerns and find out if there is any empirical  
14 data to help guide us.

15                  DR. ROBERTS: Okay. With that, let's move on to  
16 question number 2.

17                  Dr. McMahon, would you read the question for the  
18 panel, please.

19                  DR. McMAHON: Yes. Thank you, Dr. Roberts. Our  
20 second to the question to the panel, as was alluded to, deals with  
21 the relative bioavailability of inorganic arsenic from soil.

1                   Our question reads: Please comment on the choice of  
2   this data set; that is, the data of Dr. Roberts, using a value of 25  
3   percent bioavailability for representation of the relative  
4   bioavailability of inorganic arsenic from ingestion of  
5   arsenic-contaminated soil.

6                   Please discuss the strengths and weaknesses of the  
7   selected data, and also provide an explanation as to whether this  
8   25 percent value is appropriate for estimation of bioavailability in  
9   children.

10                  DR. ROBERTS: Dr. Bates, can you lead off our  
11   discussion on that topic.

12                  DR. BATES: I think Dr. Kosnett is going to --

13                  DR. ROBERTS: Dr. Kosnett, would you lead off our  
14   discussion on this question?

15                  And before you do, Dr. Bruckner has to leave the panel  
16   shortly, and it's important that I guess we get his comments into  
17   the record before he takes off.

18                  Would you object if he made his comments very  
19   quickly?

20                  DR. KOSNETT: No. Please go ahead.

21                  DR. BRUCKNER: The first question I would like to

1 address is a little bit different. I'm a little bit concerned about  
2 your assumption of 100 percent availability from, let's just say,  
3 the soluble salts of sodium arsenate. I'm just looking back at some  
4 of the data.

5                   Some of the human studies by Buchet and some of the  
6 others -- it looks like the numbers in humans vary from about 55 to  
7 80 percent. And then with the two monkey studies we have by  
8 Roberts and by Freeman, we're looking at 68 percent and 74  
9 percent.

10                   And then, from Dr. Aposhian, we heard 10 to 20  
11 percent, although I do have some concerns about -- one we talked  
12 about before, biliary excretion may have affected that one. He was  
13 saying 10 to 20 percent absorption.

14                   I guess my point, summing it up here, is that the data  
15 don't support a 100 percent assumption.

16                   And availability from soil, I think the thing that strikes  
17 all of us, probably, is the variability that we have in those  
18 estimates. There's not really the consistency.

19                   There is consistency, I guess, in the two primate  
20 studies. One, I think, shows 14 to 19 percent; and the other, 11 to  
21 25 percent. Of course, the whole point is in what form is the

1       arsenic in? What source -- we have only looked at a very limited  
2       number of uncharacterized soils, so there is an incredible  
3       variability, incredible inconsistency.

4               The only consistency I see is really in the two primate  
5       states where the values don't vary that differently. So I just -- I  
6       guess, we have the Rodriguez study in the swine, 3 to 43 percent  
7       which just shows, again, variability.

8               I guess I'm most comfortable with the two primate  
9       studies. But, again, I'm very concerned because those are so  
10      limited in numbers of soils, numbers of animals, numbers of  
11      samples.

12              Just one other question. My area is more or less -- I  
13      think the reason I'm here is pharmacokinetics in infants, children,  
14      juveniles and adults. It appears we don't have any information on  
15      relative pharmacokinetics, the child versus the adult. We don't  
16      know whether there is a difference in methylation. I guess we're  
17      not really sure if methylation increases or decreases toxicity.

18              And I just wanted to put in a strong urge that there be a  
19      high research priority just to look and see if the kinetics and  
20      metabolism and tissue deposition and toxicity, in turn -- I don't  
21      see any toxicity studies even in an animal model between, you

1 know, juveniles and adults. So I just would like to say that's  
2 really a black box, which really needs some research.

3 DR. ROBERTS: Thank you, Dr. Bruckner.

4 Dr. Kosnett would you quickly give us your comments?

5 DR. KOSNETT: I think an area in which there is  
6 general scientific consensus is that there is a large number of  
7 physical, chemical and biological factors that impact the extent of  
8 gastrointestinal absorption of a substance, such as metal, in soil  
9 relative to the absorption of the same substance if it was in  
10 solution.

11 And chemical factors are manifold, including the  
12 molecular form, the arsenic species, the nature of the chemical and  
13 physical interaction with the constituents of the soil matrix,  
14 whether it's chemically bound, absorbed, complexed,  
15 encapsulated, the size peroxidi, compaction and surface area of the  
16 arsenic-containing soil particulates.

17 And there are a number of biological factors as well:  
18 Species-specific metabolism; physical condition of the animal at  
19 the time of ingestion -- animal including a human; the effect of  
20 drugs; physical stress; toxins; nutritional perturbations; disease  
21 states; the presence of other ingested food, whether it's given on



1 an empty stomach or not; whether there are other drugs or other  
2 substances in the intestinal tract and, in some cases, as you  
3 mentioned, the age of the -- or the developmental stage of the  
4 animal.

5 And another key factor is the dose regimen in which  
6 it's administered. For example, the absolute bioavailability in  
7 terms of percent of the administered dose could vary depending on  
8 whether it's administered as a single large bolus or whether it's the  
9 same amount, overall amount is given in smaller divided doses.

10 And because of this variability, both from the aspects  
11 of the soil and the matrix in which the arsenic is present and  
12 host-specific factors and because of some limitations and  
13 uncertainties in the existing studies, I think it would be -- I don't  
14 think that the studies cited by EPA in the material they provided  
15 affords us a sufficient basis for establishing a relative  
16 bioavailability of 25 percent for arsenic in soil as a consequence  
17 of CCA-related release.

18 And in terms of the specific aspects of the study, one  
19 of the key major concerns I had with the study by Roberts, et al.,  
20 and Freeman, et al., is the fact that it did not simulate to a  
21 reasonable degree the relatively low dose repeated hand-to-mouth

1 behavior of children with respect to their ingestion of soil.

2           The arsenic concentrations used in those studies  
3 ranged from a low of 101 to high of 743 parts per million which,  
4 based on discussions we had yesterday, appear relatively high  
5 compared to those that had been measured in the vicinity of  
6 CCA-treated structures in children's playgrounds.

7           And also, in the studies in question by Roberts, et al.,  
8 and Freeman, the soil was introduced into the test monkeys in a  
9 single high dose bolus. For example, in the single soil sample that  
10 is in the Roberts site, which is cited as coming from a wood  
11 treatment site, it can be calculated that the soil-associated arsenic  
12 dose of .3 milligrams per kilogram of body weight was achieved by  
13 administering to a three-kilogram monkey a single oral dose of  
14 9,000 milligrams of soil.

15           In like manner, in the Freeman study, monkeys which  
16 weighed between two to three kilograms were given single oral  
17 doses of 3,000 to 4,500 milligrams of soil, containing 410 parts  
18 per million arsenic.

19           And I think, under those circumstances, when you have  
20 a high-mass single bolus, it could cause the relative  
21 bioavailability to appear lower than it actually might be.

1                   In fact, I think there is reasonable confidence that had  
2                   the same amount been given in smaller divided doses or the same  
3                   concentration been given in smaller doses, the bioavailability  
4                   would be higher.

5                   I think there is also significant uncertainty used in the  
6                   available database. Specifically, the studies by Roberts, et al.,  
7                   and Freeman, et al., reflect the character of the arsenic in the soil  
8                   matrices encountered in the vicinity of CCA contamination at a  
9                   playground.

10                  Although we have that single soil sample from the  
11                  investigation by Roberts, et al., as identified as coming from a  
12                  wood treatment site, the sample was not characterized further.  
13                  And we don't know whether the arsenic in that soil might have  
14                  resulted from direct spillage of raw CCA product onto the soil  
15                  rather than the leaching of arsenic from a weathered piece of CCA  
16                  wood.

17                  And even had it been reflecting leaching from  
18                  weathered wood, the characteristics of the soil in that particular  
19                  area could -- we have very low confidence, I think, that that would  
20                  be representative of the soil matrix elsewhere around the country.

21                  There are some additional factors as well, and these

1     pertain to the animal model. The animal is a primate model, and  
2     although that may have certain strengths with respect to the fact  
3     that humans are primates as well, obviously, it's of note that  
4     certain non-human primates actually have a metabolism of arsenic  
5     that might be substantially different than that of humans.

6             For example, the marmoset monkey, which is a New  
7     World monkey, like the monkeys used in these studies, is  
8     noteworthy for not methylating arsenic at all and for having a  
9     phase of retention of arsenic which is substantially longer than  
10    that of humans.

11            And the four-day urine collections that were used in  
12    this study to obtain the amount of arsenic excreted in the urine  
13    could conceivably not be sufficient in this single dose model that  
14    was used.

15            In addition, I think, although I can't say certainly, that  
16    the magnitude of any effect that it might have -- I think there has  
17    to be some concern that, in this particular model, particularly in  
18    the model by Dr. Roberts and colleagues, the animal was  
19    administered the dose under general anesthesia and during  
20    intubation. And it's conceivable that anesthesia has effects on  
21    gastric motility and cardiac output and other factors that might

1 influence the mobilization, metabolism and excretion in the  
2 short-term. And the short-term may have substantial factor in  
3 studies of this nature.

4 So with that in mind, I feel that there is not sufficient  
5 confidence in relying on those two studies as a basis for setting an  
6 across-the-board relative bioavailability of 25 percent.

7 I would echo what our colleague, Dr. Benson has said  
8 the other day, that in region 8 -- I live in region 8, and I agree with  
9 him that it's valuable to do site-specific evaluations.

10 I also think that future study designs should consider  
11 not just doing a single dose administration, particularly a single  
12 dose high-dose administration, that it would be better to use  
13 multiple-dose studies at a range of doses. And on the handout that  
14 just went around, this three-page handout -- for example, if you  
15 turn to the second page where there is a series of graphs, if you  
16 look in the lower right-hand corner, for example, this is from a  
17 swine study that was recently done on a number of soils in north  
18 Denver.

19 And these soils contain various amounts of arsenic,  
20 inorganic arsenic. And you can see that what they did is they took  
21 multiple-dose ranges administered over several days and

1 established a regression relationship, a slope. And it was a slope  
2 of multiple dosing as opposed to a single high-dose bolus that was  
3 used as a basis for looking at the relationship between the amount  
4 of arsenic excreted in the urine and the amount of arsenic  
5 administered. And I think studies of this nature have certain  
6 advantages in terms of offering more robust estimations.

7           It may be necessary in the context of looking at  
8 low-dose studies to consider more elaborate methods such as radio  
9 tracer methods, which would have the capacity of accurately  
10 measuring low-dose absorption.

11           So with that, I would just conclude by saying that I  
12 think that the current database should be expanded upon with  
13 additional research and site-specific studies.

14           DR. ROBERTS: You won't be surprised that I may  
15 have several responses, I think, to some of your comments. But I  
16 would like to hold those for a little bit. But let me ask you if you  
17 would -- since going out and collecting more data would -- you  
18 know, that's a very time-consuming proposition. So do you have  
19 an interim recommendation for the department in terms of an  
20 assumption of bioavailability from soil?

21           Should they default to the 100 percent relative

1 bioavailability or should they -- I guess I'm asking you, and you  
2 may not have an opinion on this. What should they do in the  
3 interim?

4 DR. KOSNETT: I actually omitted one additional  
5 point for the record, which I also want to make my colleagues  
6 aware of, and that is there is a broad range of -- there has been a  
7 broad range of bioavailability in other studies, looking at  
8 inorganic arsenic in soil that's exceeded 25 percent. These have  
9 recently been -- recently tabulated in an article in Environmental  
10 Science and Technology that recently appeared.

11 And, in fact, there was one particular study, although it  
12 used low-dose, relatively low-dose soils, in Aspen, Colorado --  
13 and Bob, you are probably aware of this -- in which the  
14 bioavailability was actually well in excess of 50 percent.

15 So the existing database doesn't identify a clear  
16 number. The nature of bioavailability of arsenic in soil is that it's  
17 very variable. And I think decisions on remediation and action at  
18 a site should be based on studies done at that site on site-specific  
19 data.

20 I think that no generic basis can be invoked. I think  
21 sometimes in the process -- and perhaps Dr. Benson could answer

1 as well -- in situations where there just isn't any information, it's  
2 often left to the PRP to take action to do that. Or else sometimes a  
3 default level of 100 percent, which we generally feel would not be  
4 the case, would be accepted. But that's a motivation to do studies.

5 DR. ROBERTS: I just want to be clear on this. Is your  
6 recommendation to use a default of 100 percent until site-specific  
7 data could be available? What are you proposing that they do?

8 DR. KOSNETT: I'm proposing that they ask for  
9 site-specific study and promptly fund more research.

10 And in the absence of that, they use their judgment on  
11 a case-by-case basis, taking into consideration all the factors in  
12 reaching a decision.

13 DR. ROBERTS: Yes, but I think one of the things they  
14 are trying to do initially is get sort of a broad cut on these and,  
15 rather than looking at playground by playground, come up with  
16 sort of an initial assessment.

17 So I don't mean to press you, Dr. Kosnett if you don't  
18 have an opinion on this. But I'm trying to get from you what I  
19 think the agency is looking from the panel in terms of  
20 recommendation, which is, if the study or 25 percent is not  
21 satisfactory, what does the panel recommend?



1                   And I think that, you know, going out and collecting --  
2   I think at this point we're not looking at individual sites. I think  
3   we're looking at sites with playscapes, so we kind of need a  
4   number.

5                   DR. KOSNETT: Okay. One could do the following,  
6   and sometimes in a case when one does a range of exposures, a  
7   range of possibilities and does a sensitivity analysis, that would  
8   range everything down from the full spectrum of what's been  
9   observed in bioavailability down to from, say, 5 percent up to 98  
10   percent, and enter that into the possible equation.

11                  If, based on every other, factor it's considered that  
12   within that range there still might be action taken, then a  
13   site-specific decision based on limited data and based on the range  
14   of possibilities and how that factors in can be made.

15                  And that's a decision that, I think, the agency is not  
16   going to be uncomfortable with. They face that now with many  
17   other things as well, where they don't have good data to drive it  
18   and they have to use a site-specific basis or else just set a broad  
19   range and see, even at the extremes of range, there might be a need  
20   for action.

21                  But I think -- and I firmly believe this -- on the issue

1 of the bioavailability of arsenic from soil, it will almost always  
2 have to be driven by site-specific answer and not necessarily by a  
3 generic number.

4 DR. ROBERTS: Dr. Vu, I think you perhaps had a  
5 point to make.

6 DR. VU: I appreciate Dr. Kosnett's perspectives and  
7 recommendations. As you know, in the Superfund program, you  
8 could afford doing site-specific kind of sampling. One of the  
9 decisions that the Office of Pesticide Programs is to make is, as a  
10 whole for nationwide, what would be the appropriate scientific  
11 data that should be used.

12 And I think you have also recommended the other  
13 approach. If you don't have site-specific or kind of  
14 playground-specific kind of scenario, then use the range. And  
15 that's one recommendation we certainly consider.

16 The Office of Pesticide Programs has proposed to pick  
17 25 percent only because of looking at -- the Office of Pesticide  
18 look at the range of data and select the monkey as most appropriate  
19 data, et cetera.

20 But given your perspective, what I'm hearing, is that  
21 pick a range as part of the analysis if we have to.

1 DR. ROBERTS: Let me ask the other lead discussants  
2 on this question if they have anything to add.

3 Dr. Bates, I think you were originally first on the list.  
4 Did you have anything to add to this?

5 DR. BATES: I just would like to say -- well, I'm not an  
6 expert on this, but I would like to make a few comments.

7 First of all, I appreciate what Dr. Kosnett says about  
8 the limitations of the study and small numbers of animals and so  
9 forth.

10 But from a practical point of view, I accept that the  
11 EPA needs to have some sort of perhaps default value which it can  
12 use in these circumstances.

13 And I have had the privilege of being able to read a  
14 more detailed manuscript for the study, even though it's not yet  
15 published, and I appreciate that the great difficulties that are  
16 entailed in doing a study of this nature. It's very expensive. And I  
17 don't believe, myself, that it would be practical to do any sort of  
18 site-specific estimates.

19 I think some sort of general -- perhaps occasionally it  
20 would be possible. But in general I can see the need for some sort  
21 of value that can be applied broadly. So I accept that.

1 I also think that, despite the limitations of the studies,  
2 these are the best data that we have. And I support the need for  
3 more research to be done, particularly to confirm these results.

4 But I think, in the absence of any other data, I can  
5 certainly go along with a relative bioavailability of either 25  
6 percent or perhaps, say, the upper confidence limit of the mean,  
7 which would be about 18, I think. So something in that region I  
8 would be entirely comfortable with, personally.

9 DR. ROBERTS: Let's see. Who else is on the hook for  
10 this one? Dr. Bruckner has given us his comments. Dr. Styblo?

11 DR. STYBLO: Well, I'm last in the row and there is  
12 not much I can add.

13 Unlike Dr. Bates, I agree completely with what Mike  
14 Kosnett said, which covers basically what we discussed prior to  
15 this session.

16 I think the only correct approach for estimates for  
17 bioavailability is to go to real-life sites, to use real-life samples.

18 The advantage of this approach is that samples taken  
19 from these sites, soil or dislodged material, would reflect  
20 correctly arsenic speciation in both organic and inorganic  
21 background that is associated with particle size to get even better

1 estimates. It is essential that several sites from different regions  
2 with different soil types are chosen.

3 We can guess numbers here based on studies that are  
4 available, but I'm not sure we are here to guess numbers.

5 I don't think it would take too much to do this study. I  
6 think that it is essential that this study is done.

7 I don't know how else we can derive numbers. As  
8 Dr. Bates said, we can pick any of the numbers presented in  
9 previous studies and we could be wrong, you know, by two, three  
10 times margin. We may be correct.

11 One more issue that was briefly mentioned by  
12 Dr. Bruckner is the biliary circulation of arsenic which may bring  
13 another uncertainty to delivery of the availability coefficient as it  
14 is calculated now using urinary excretion versus total, meaning  
15 fecal plus urinary, disregarding the excretion of arsenic in hair,  
16 which could be, or it may not be, significant.

17 The optimal arrangement for an experiment would be to  
18 use possibly primate or several primate species with known  
19 metabolic profile for arsenic as close as possible to human  
20 metabolic profile and with known biliary circulation of arsenic,  
21 with known pattern of biliary excretion of arsenic. That would be

1 the optimal arrangement. The question is how close we can get to  
2 it.

3 I'm reluctant to come up with any number at this time  
4 unless these requirements are at least partly, partially met.

5 That's about it.

6 DR. ROBERTS: Let me go ahead and take -- we do  
7 have another designated discussant that was added, and it's  
8 Dr. Mushak. And let me get Dr. Mushak's comments.

9 DR. MUSHAK: I'm in the amen corner with a lot of  
10 what Dr. Kosnett says. I would add to that the factor of  
11 developmental age.

12 We assume that children absorb at a higher rate across  
13 metals and metalloids. This is established in the case of lead. It's  
14 established for other metals in the case of animal models. And  
15 absent evidence that it doesn't show this -- that kids, you know,  
16 are not different in terms of their uptake, we have to assume that  
17 they are.

18 I think that the age of the monkeys here are a problem.  
19 Dr. Roberts, could you tell me the age of the monkeys you used.  
20 Harry Freeman's monkeys were three years old.

21 DR. ROBERTS: They'e adults. They're probably about

1 in the same age range.

2 DR. MUSHAK: So there may be question of uptake, as  
3 well as the other factors.

4 I think maybe the best thing to help the agency with  
5 would be, in the interim, to offer maybe a range of, say, the  
6 monkeys on the low end and the UCL for the pigs on the upper  
7 range, maybe 25 to 45 percent as an interim measure.

8 I don't think that it's useful to consider that you have  
9 to do site-specific stuff for every playground in the country. I  
10 mean, without engaging in understatement, this has potential for  
11 considerable logistical mischief.

12 I think that what we might want to do is look at  
13 selective soils by region or selective soils by type, impact type,  
14 kids who use playgrounds that have buffering soil underneath. In  
15 other words, classify by group as interim measure. You are not  
16 going to be able to look at every playground site. I think that's  
17 infeasible for anyone.

18 And it's not useful to compare this to Superfund.  
19 Superfund, basically, has PRPs who are corporate defendants who  
20 will, if they don't like, say, a generic uptake rate in an IEUBK  
21 model, they can go out and do their own animal studies. In fact, a

1 lot of the literature that's out there on bioavailability are  
2 commissioned by PRPs to essentially rebut EPA default factors in  
3 their modeling.

4 So I would say that probably a range that  
5 accommodates younger animals such as we see embedded in the  
6 young pig model might be useful as a number. I don't want to  
7 discard the monkey models. I think, though, they have a number of  
8 problems with them. I agree, I think the bolus problem is a real  
9 concern.

10 And as Dr. Benson indicated yesterday, if you are  
11 going to look at the best animal model, you have to standardize  
12 everything. And that hasn't been done.

13 And also the metabolic factor that Dr. Styblo has been  
14 talking about, depending on how you characterize or quantify  
15 bioavailability, the metabolic profiles may or may not be a major  
16 factor.

17 DR. ROBERTS: Any other comments?

18 Dr. Gordon?

19 DR. GORDON: I'm also uncomfortable with the use of  
20 data using soils, as I said a couple of days ago, that aren't the real  
21 stuff.



1                   So -- but I'm comfortable with saying that maybe it  
2                   should be over 25 percent, given what Dr. Mushak pointed out, the  
3                   other animals --

4                   DR. ROBERTS: I'm sorry. Just for clarification, by  
5                   "not the real stuff," can you --

6                   DR. GORDON: The dislodgeable or the runoff of the  
7                   leached material from the playground soil and the soil underneath  
8                   is what should be used in these studies, not from a CCA-treated  
9                   plant or sawdust.

10                  And because of that, I think the value should probably  
11                  be above 25 percent for the uncertainty factor that we don't have  
12                  the data from studies with animals using the correct soil.

13                  DR. ROBERTS: And would you care to venture a  
14                  number?

15                  DR. GORDON: No.

16                  DR. ROBERTS: Fair enough.

17                  Dr. Ginsberg?

18                  DR. GINSBERG: I think that there is -- a lot of  
19                  uncertainty has been said at this table. I agree with a lot of what  
20                  Dr. Kosnett started us off with. I do think that we have to think  
21                  about what the materials are that are going to be underneath a

1 playscape. A lot of it will be sand, which may be independent of  
2 part of the country; it may not.

3 I don't know if you get Atlantic Coast beach sand out  
4 in Denver for a playscape or whatever. But sand in general with  
5 large particle size and with good leaching properties, I would  
6 think would have higher RBA than backyard dirt, you know, if  
7 there is a residential playscape where somebody didn't use a  
8 buffering material.

9 So I think it does depend upon how you construct the  
10 exposure scenario.

11 I think, for the purpose -- well, my personal bias,  
12 without having a lot of data in front of me, would just be that,  
13 sure, you know, arsenic bioavailability from a solid matrix,  
14 absorbed onto a solid matrix is going to be less than sodium  
15 arsenate in water.

16 How much less? You know, if I had to do a risk  
17 assessment right now and throw a fudge factor at it or look at all  
18 the data sets that I've seen and come up with a fudge factor, I  
19 would probably use 50 percent, given -- so there is my number --  
20 given that it's probably, in this case, a lot of sand that we're  
21 talking about, so it's going to be higher than some other soil

1 matrices that make it lower, might retard it more.

2                   The concern about children. Closure of the small  
3 intestine villi in terms of pinocytotic action where a lot of metal  
4 absorption occurs, in animals is at weaning; in humans, we don't  
5 know what that age is.

6                   There are some theories that a lot of milk in the  
7 stomach enhances lead absorption. There is also other nutritional  
8 interactions with some metals that may be different in young  
9 children than at older ages.

10                  By the time that kids are out in playscapes, at parks,  
11 ingesting a lot of dirt and soil, I think a lot of that really high  
12 phase of bioavailability in the GI tract is probably over. It's still a  
13 factor, but I don't think it's nearly as big as in, you know, the first  
14 six months of life.

15                  So I'm not sure I would put a lot of stock into the  
16 young child concern about bioavailability, but I think it would  
17 weigh in somewhat. But these are all gut-feel, qualitative thought  
18 process. You know, I'm not basing on a good, solid study which  
19 I'm concerned about and which might tend to make me default a  
20 little bit higher than I would otherwise if there was a good -- if  
21 that 25 percent number was on a study that I really liked in terms

1 of the way the dosing occurred and, you know, just the relevance  
2 to an exposure scenario.

3 So I guess I would just sort of -- because I feel that,  
4 compared to water -- sodium arsenate in water, it does make sense  
5 that there would be some decrement due to retarding on a solid  
6 matrix.

7 You know, I could believe it would be somewhere  
8 around 50 percent as a general average, applicable to playground  
9 sand and other playground materials.

10 DR. ROBERTS: Dr. Chou is next. Then Dr. Mushak  
11 and then Dr. Clewell.

12 DR. CHOU: I agree with all my colleagues said. I feel  
13 very uncomfortable making a decision based on not enough  
14 scientific evidence. However, I also understand this is a decision  
15 we're asking to make across the nation. Therefore, the  
16 site-specific is not possible in this case.

17 We talk about how to make this decision. One concern  
18 is the children-adults difference. Usually, we say children  
19 probably would take in a higher substance -- there is many  
20 evidence. However, in this case, especially in soil case, we are  
21 also looking at digestion, not only the absorption.

1                   There is no evidence to say that children would have a  
2                   higher ability to digest; therefore, would have more available.

3                   So without any data to tell me left or right I should go,  
4                   then I have to assume there is no difference in this case, at least at  
5                   this moment.

6                   Then we look at what numbers can we choose. Often,  
7                   when we are not sure what number to choose, we say 100 percent.  
8                   That's one of the practices.

9                   The other one is we say, okay, based on the existing  
10                  data, what is the maximum, the most conservative number. I  
11                  would go with 50 or 60 percent. That's the highest number we  
12                  know possible based on the existing data.

13                  Then we can go with another decision, what is the best  
14                  judgment, what is most likely. Based on the existing data, again, I  
15                  would say 25 is probably -- you know, we can say, well, most  
16                  likely.

17                  So without the -- the three numbers I've been thinking  
18                  about, I think this case I'm willing to look at a possibility between  
19                  25 and 50.

20                  DR. ROBERTS: Thank you.

21                  Dr. Mushak?

1 DR. MUSHAK: I would like to respond to Gary  
2 Ginsberg's comments about when the differential for uptake might  
3 terminate vis-a-vis when kids are mobile.

4 I think to the extent we can hang any comparison on the  
5 lead picture, there are data that basically take this out to three to  
6 four years at least.

7 You can look at Ellen O'Flagerty's (ph) studies in the  
8 aggregate when she does her PB/PK model development. I have  
9 worked with that model and Ellen and I have interacted fairly  
10 closely in terms of where she thinks and can calculate where the  
11 differential uptake, at least for lead, occurs. If you look at  
12 Alexander's studies, it's clear that while there is a broad range  
13 there, that there is a fairly uniformed differential uptake, probably  
14 out to four or five.

15 If you look at stratified age data in the longitudinal  
16 studies out of Port Pirie (ph), Australia, and look at -- if you plot  
17 the blood lead behavior on a group basis, you find that around  
18 three to five you start seeing a marked decay of what appears to be  
19 uptake difference contributing to overall blood lead.

20 So I would take exception to the comment that  
21 playground kids are not -- uptake differences are not an issue for

1 playground kids. I think they are. Unless you keep day care,  
2 certainly, I think, where kids are apt to be young are apt to have  
3 much more exposure. Probably those kids could be three or four  
4 years old. And there, I think, there is an argument for this.

5 Scientific reasonableness would dictate it can't be  
6 ignored.

7 DR. ROBERTS: Dr. Clewell?

8 DR. CLEWELL: I have a little trouble with the  
9 analogy to lead since lead is a cation and a metal and arsenic  
10 comes in as an anion and a metalloid.

11 But I don't really have any specific information on  
12 arsenic uptake, although it was mentioned the other day that it's a  
13 phosphate transport for the arsenate and passes diffusion for  
14 arsenite.

15 So I think we can get too tangled up in this question of  
16 whether there is enhanced uptake. There have been several good  
17 points made about reasons why one might want to be conservative  
18 about the selection of the relative bioavailability. One is that  
19 there is less than 100 percent uptake of the water-borne arsenic.

20 In the relative bioavailability studies, are those  
21 numbers -- 25 percent, is that a comparison of the uptake for

1       arsenic in water versus arsenic in soil?

2                       DR. ROBERTS: Yes.

3                       MR. CLEWELL: So then that is figured in for those.

4       And I believe, in my mind, as a pharmacokineticist, that takes care  
5       of the question about biliary excretion because they are both  
6       subject to that. So what you are looking at is the relative systemic  
7       availability of these as shown by the elimination in the urine  
8       where they are both subject to the same biliary excretion.

9                       And I believe Dr. Kosnett's concerns are well spoken,  
10       but experiments are like that.

11                      And so I have a lot of confidence in the 25 percent  
12       number. The pig numbers, which are higher, also have a lot to be  
13       said for them. I kind of like the suggestion that, since there is  
14       some uncertainty here, perhaps rather than having to focus on a  
15       single study, the general weight of evidence should be used and a  
16       number in between the kind of the ranges of 25 and 50 should be  
17       chosen, something around 35 or 40.

18                      DR. ROBERTS: Dr. Styblo, before you comment,  
19       because I think I know what you're comment on, let me just make a  
20       brief statement about the biliary excretion and some information.

21                      People have looked at this, at biliary excretion of



1       arsenic -- and I can tell you from our studies on intravenous  
2       administration of arsenic, you get less than 1 percent of total  
3       arsenic excreted in the feces. And that's probably the best way to  
4       assess biliary excretion.

5                     DR. STYBLO: No, it's not.

6                     DR. ROBERTS: Well, there can be some reabsorption,  
7       but I think it's certainly -- even that I'm not sure is a problem with  
8       the model.

9                     Let me finish. And the same thing. Studies in humans  
10       looking at radio-labeled tracers find less than 1 percent excreted  
11       in the feces which, again, suggests that if there is biliary  
12       excretion, it's probably very small.

13                    Just kind of wanted to throw that in. Obviously, if you  
14       were to do the experiment -- if you wanted to eliminate it entirely,  
15       I agree you would do a cannulated animal, you would interrupt the  
16       bile flow and then you could know for certain.

17                    But I would have to say that, in all the animal models  
18       or animal studies that I'm familiar where arsenic has been  
19       administered intravenously, there is also a very, very low  
20       excretion in the feces which suggests minimal biliary excretion.

21                    Dr. Styblo.

1 DR. STYBLO: I cannot disagree more.

2 The problem with all the studies that you just  
3 mentioned is that people inject one particle form of arsenic, which  
4 is usually arsenate or arsenite in aqueous solution, usually.

5 Agree? All right.

6 There is a number of work done, mostly in group of  
7 Dr. Gerasich (ph) and Gregrich (ph) in Hungary. This group  
8 actually came up with very nice data on biliary excretion in  
9 animals.

10 The last piece of the work published -- actually, not  
11 published; it's submitted for publication -- I was lucky to actually  
12 see the manuscript -- showed clearly that the amount of arsenic  
13 excreted in bile or present in bile circulation -- and the rate by  
14 which this arsenic appears in bile depends strongly on arsenic  
15 species that are administered to the animal. Okay. And we are bad  
16 in the species issue and metal interactions issue.

17 So I suggest that biliary excretion, the rate, both  
18 quantitative and qualitative issues, would differ when you use  
19 arsenate, especially in aqueous solution, and when you have  
20 complex mixture of arsenic species or combined with other organic  
21 and inorganic matter.

1                   I would be inclined to agree with you that biliary  
2                   excretion may not be a big issue, but it gives us certain level of  
3                   uncertainty.

4                   Just to make this point stronger, we have little  
5                   information of arsenic speciation. As I mentioned yesterday, it is  
6                   generally accepted that arsenate is the main species.

7                   We heard some -- and I appreciate data provided  
8                   yesterday by Dr. Townsend from the University of Florida. These  
9                   were done in two samples, as far as I understood. In talking to him  
10                  afterwards, I found out that there is significant fraction of arsenic  
11                  that could not be analyzed from these samples because it's not  
12                  soluble or it's not analyzable by HPLC, which is an unknown kind  
13                  of species.

14                 So another argument to consider arsenic species is  
15                 presence of microbial organisms on both CCA-treated foods and in  
16                 soil. I ask the EPA staff to distribute copies of paper that deals  
17                 with biochemistry and environmental biochemistry of arsenic.  
18                 And I think we would need environmental chemists on this  
19                 problem. It would help a lot.

20                 To point out that presence of this microbial species,  
21                 especially those that are able to methylate arsenic -- and there are

1 many of them on the wood, including CCA-treated wood suggests  
2 that there could be other types of arsenic present in both  
3 dislodgeable material and in the soil.

4 Because of that, we don't know what would be the  
5 contribution of biliary circulation to arsenic excretion.

6 DR. ROBERTS: Let me say, because I'm the author on  
7 the study that the EPA has relied upon, I don't know it's  
8 appropriate for me to comment whether or not they should use it. I  
9 think that's sort of a conflict of interest or something. But at any  
10 rate, I'll recuse myself from that recommendation.

11 But I would like to comment a little bit about the  
12 model because it's germane for the discussion about future  
13 research, which I would endorse. And I would also say that I  
14 generally agree with most of the comments that have been made  
15 about the uncertainties associated with taking soil samples from  
16 mine tailings or even a CCA site and trying to extrapolate that to  
17 other kinds of situations. I agree that the evidence indicates that  
18 there are several factors that can influence -- associated with the  
19 chemical and the soil -- that can influence bioavailability.

20 But in regard to the animal model, one is, I think that  
21 in terms of -- Dr. Kosnett mentioned that the animals were

1 administered the dose under general anesthesia, and I'd like to  
2 correct that because the animals are sedated lightly while we  
3 administer the dose, and that's to minimize stress to the animal  
4 which can have an effect also on gastrointestinal absorption.

5 We spent about a year and a half finding ways to dose  
6 animals that minimize effects on the GI tract and absorption.

7 And there's also going to be some uncertainties with  
8 the way that you do this. But judging by our comparisons with  
9 absorption excretion in humans, I think we got it pretty close.

10 There is an issue about bolus doses. I agree with that.  
11 And that's an issue with -- not only with the monkey but I think  
12 with the swine, too. They give more doses, but they are still much  
13 larger doses than what children would be getting in terms of soil.  
14 And they are also for, obviously, much shorter periods of time.

15 This is not an issue that we haven't thought of. I think  
16 the reason that these studies are done the way they are done is just  
17 the practical hurdles and limitations of trying to measure  
18 bioavailability in animal models.

19 I guess what I'm saying is that I don't know. Ideally,  
20 we would measure -- give repeated doses of 100 or 200 milligrams  
21 of soil and measure bioavailability, but I don't think right now,

1 with the technology we have, that that can be done.

2 Now, it was suggested that perhaps you could use  
3 radio-labeled material, and that would give you the sensitivity in  
4 measurement that you need. But the problem is if you spike it into  
5 the soil, you don't allow the aging process to take place, which  
6 could affect bioavailability and that's, of course, a criticism of  
7 one of the dermal studies that we're going to talk about. If you age  
8 the soil, then you don't have any radioactivity left.

9 So there are some real issues and problems, and I  
10 certainly acknowledge the uncertainties, but we talk about going  
11 ahead with research. I want the panel to be aware that people that  
12 are trying to assess bioavailability have thought about these things  
13 and are trying to do the best they can, but there are some real  
14 technical problems associated with doing that.

15 I think that for -- let me also talk about the role of  
16 metabolism because that was raised by a public commenter and has  
17 come up a couple of times today.

18 I think that bioavailability, as we're looking at it now,  
19 which is simply movement of arsenic into the animal and  
20 movement of arsenic out of the animal -- I don't think metabolism  
21 really matters. Now, I say that knowing that, certainly, depending

1 upon how you define bioavailability and what you are interested  
2 in -- metabolism in the liver, of course, can be very important,  
3 classically-defined bioavailability is the fraction of the material  
4 that enters the system circulation and in a particular form.

5 But -- and maybe at some point we will have enough  
6 information about various metabolites and species and maybe some  
7 suggestion that, depending upon the form in which you come into  
8 contact with it can influence its metabolism, it will be very  
9 important to have a model where the metabolism mimics humans.  
10 But right now, for the kinds of bioavailability studies that are on  
11 the table right now and we're talking about, I don't think  
12 metabolism is really an issue. What's at issue is, is the absorption  
13 of arsenic the same into the body and is the excretion essentially  
14 the same as humans such that whatever the animal is serves as a  
15 good model?

16 So I would say, at least at this state in our  
17 understanding of absorption bioavailability studies, I don't know  
18 that metabolism is as important as getting a species for which  
19 arsenic -- the digestive handling and absorption is the same, or as  
20 close as we can get to humans.

21 There is another point that I -- another uncertainty that

1 I might as well throw out into the table, and that is that all of these  
2 studies are done on animals that are fasted or at least have an  
3 empty stomach. And does the presence of food affect  
4 bioavailability?

5 Perhaps. And maybe -- and I guess if you had to guess,  
6 you might guess that the presence of food might interfere with  
7 absorption. So in that sense you might say the bioavailability  
8 measurements are, in a sense, kind of conservative because they  
9 are being -- from that one aspect, because they are all done on  
10 empty stomachs or on fasted animals.

11 But, again, it's another uncertainty in terms of how  
12 what we're able to measure on animals reflects what's going on in  
13 children in playgrounds, for example.

14 Anyway, I just wanted to throw those points out. I  
15 think I got them all.

16 Any other comments on this issue?

17 Dr. Ginsberg?

18 DR. GINSBERG: I don't want to lose site of EPA also  
19 presenting to us data on in vitro simulations of gastrointestinal, I  
20 guess, digestion or breakdown of -- I guess dissolution, leaching  
21 of arsenic off of particles.



1                   I don't have an opinion one way or the other of how  
2   relevant those. Before we leave this topic, I just wanted to hear  
3   people who know more than I do about it how much EPA should  
4   rely upon those kind of data which, by the way, do show 15 to 20  
5   percent -- you know, suggest that amount of leaching off of soil.  
6   So that would tend to make you think that it would be on the low  
7   side. But I don't know how important those data are.

8                   DR. ROBERTS: Dr. Mushak?

9                   DR. MUSHAK: The problem with any kind of in vitro  
10   study which has as its focus bioaccessibility, just simply  
11   solubilization is that it's a simplistic surrogate for what is  
12   integrated in the body of the child, or the adult for that matter.

13                  We have seen this problem with other elements, that  
14   you have everything from a thermodynamic difference because you  
15   have an open reservoir in a GI track of a child versus a closed  
16   thermodynamic reservoir system with a vessel, this sort of thing.

17                  You have all kind of mobilization mechanisms that may  
18   go on that you don't have in an in vitro model. You pointed out  
19   pinocytosis. There's micellar formation and all of these other  
20   things.

21                  So I think that one is probably going to set a lower

1 boundary to probably -- you know, an in vitro approach would be  
2 lower boundary to what an in vivo model would be.

3 DR. ROBERTS: Dr. Kosnett?

4 DR. KOSNETT: I appreciate your comments,  
5 Dr. Roberts, with respect to the issue of metabolism.

6 The argument is made when you are looking at relative  
7 bioavailability model, that the fact that how -- you are looking at  
8 the arsenic in a soil compared to arsenate and to the extent that the  
9 metabolism in the animal with respect to urinary excretion is  
10 going to be handled the same with the reference substance as  
11 opposed to the test substance. Then that -- you are not as  
12 concerned with there being a confounding effect or complicating  
13 effect, I should say.

14 But supposing -- I think we still have to bear in mind  
15 the fact that it's not necessarily a given that the nature of arsenic  
16 in the test substance, in the soil, is going to be metabolized or  
17 handled in the same manner as the test substance -- as a reference  
18 substance such as sodium arsenate.

19 And even if there, for instance, was, as Dr. Styblo has  
20 mentioned, the impact of the presence of other metals -- we're  
21 dealing with CCA; you have copper and chromate,

1 copper-chromated arsenate -- if that could influence biliary  
2 excretion relative to the parent compound, that, I think, would  
3 make a difference, even though you don't see significant biliary  
4 excretion in the model that you used with just the arsenate.

5 And if there was a time delay or if there was a  
6 difference in the relative length of time that the one compound was  
7 excreted -- the test compound was excreted with respect to the  
8 reference compound, there could be a considerable factor.

9 And with that in mind, I just think it's worth pointing  
10 out -- and correct me if I'm getting this wrong, but in the monkey  
11 model that you looked at with sodium arsenate, in the four days of  
12 observation, the combined excretion that was recovered in both  
13 urine and feces as a percentage of the administered dose was 50.7  
14 percent, plus or minus 3.1 percent, so there was a lot of room  
15 there. I mean, half of the arsenic was not accounted for.

16 And there may be -- even if there was just a time delay  
17 issue with respect to how much were to come out within that  
18 period of observation, that could have influenced your results.  
19 Would you agree?

20 DR. ROBERTS: Let me try and put that in perspective.  
21 Yes. And basically when you give an intravenous dose in humans

1 over five to seven days, you only get 60, 70 percent back. And it  
2 has to do with the kinetics of the elimination of arsenic.

3 There are some radio tracer studies done after  
4 intravenous administration of arsenic in humans that indicates  
5 there's an initial very rapid elimination. There is a second slower  
6 phase of elimination that goes on out to about one week. And then  
7 there is a late, very slow phase of elimination.

8 And what that means is, because there is a deep  
9 compartment or a long phase of elimination, you get most of the  
10 dose back very early. But there is a significant fraction that really  
11 takes a long time to get back, actually several days.

12 The fact that the total recovery is low is consistent  
13 among models, frankly, and has to do with the kinetics of arsenic.

14 In all of our studies -- and I believe it's the experience  
15 of Stan Casteel (ph) with the swine model -- is that there doesn't  
16 seem to be any evidence of sort of a late peak or a late elimination.

17 Basically, you really get most of the dose out, frankly,  
18 in the first 24 hours or so. And after that, it falls off quite a bit.

19 I don't know that there is some bunch that's going to  
20 come out as a bolus later on so much as it's just a function of the  
21 kinetics of arsenic.

1 DR. KOSNETT: The time kinetics, even the relative  
2 amount -- the absolute amounts coming out could differ, but the  
3 time course of arsenic excretion with respect to like when the peak  
4 occurs and the tails does vary between different arsenic moieties.

5 For instance, Revotter's (ph) work has shown that there  
6 are sometimes differences with respect to whether or not you give  
7 trivalent versus pentavalent arsenicals.

8 So there could be -- even if there was a shift in the  
9 kinetics of excretion of the test substance relative to the reference  
10 substance, in a four-day period of observation, there might be  
11 room for changes in the overall amount recovered.

12 DR. ROBERTS: I don't disagree that there is going to  
13 be a shift, but just in my opinion, I don't know that we are going to  
14 miss it in the four-day period based on the data that's out there and  
15 the various samples that have been run so far.

16 Dr. Vu?

17 DR. VU: Thank you, Dr. Roberts.

18 I really think the issues of Dr. Styblo and Dr. Kosnett  
19 and Dr. Roberts are very important, but I want to bring back the  
20 context of why we asked this question.

21 The health effects data of arsenic is in aqueous

1 solution, is in drinking water or the soy sauce study, et cetera.

2 And we have to extrapolate. So that's the known health effects.

3 And even though I know that Dr. Styblo was talking  
4 about, maybe you have methylated arsenic in soil as opposed to  
5 drinking water, but all we have right now is the health effects data  
6 with regard to in drinking water or in aqueous medium.

7 We now have to extrapolate if children exposed to soil  
8 contaminated with arsenic -- what would be the differential uptake  
9 from aqueous versus soil. And that's the issue on the table.

10 And that's why I think Dr. Roberts said the metabolism  
11 doesn't enter into the equation because, if you only look at relative  
12 uptake in aqueous medium versus soil, that's what the issue is  
13 about, even though I think all the other issues are important with  
14 regard to the overall uncertainties of a health effects database with  
15 regard to this issue.

16 DR. ROBERTS: Thank you for clarifying that, Dr. Vu.  
17 And, of course, I would be happy to talk about bioavailability all  
18 day, but there's a couple of other issues that I think we probably  
19 need to get to.

20 So can we come to -- we have had a number of  
21 individuals express their uncertainty about -- or at least indicate

1       some specific sources of uncertainty in the data set. We have also  
2       had some recommendations, differing recommendations about how  
3       the agency ought to proceed on an interim basis.

4                   Is there anything that anyone would like to add to our  
5       feedback to agency at this point?

6                   Dr. Styblo and then Dr. Kissel.

7                   DR. STYBLO: Is isn't that common approach when we  
8       have a higher level of uncertainty, we go with the worst scenario?

9                   DR. ROBERTS: Dr. Vu?

10                  DR. VU: I'm sorry. I was distracted and conferring  
11       with my colleague here. Could you repeat that question?

12                  DR. STYBLO: What I said is, isn't it the case, when  
13       we have a higher level of uncertainty, that we go with the worst  
14       level scenario?

15                  DR. VU: It's typical the agency is using precautionary  
16       principle that we always use more -- public health conservative  
17       numbers. And I think that really goes down to what I'm hearing  
18       from different viewpoint from members of the panel.

19                  We have from -- Dr. Kosnett recommend a range. I  
20       forgot who wanted 50 percent. Then Dr. Chou suggested 25 to 50  
21       percent. Dr. Clewell, 25 percent.

1                   And I think Dr. Edwards explained to us that, if we use  
2                   a range, in a way you really have to do a probabilistic risk  
3                   assessment, which I'm sure later on the exposure issues -- all that  
4                   is going to come up.

5                   The Office of Pesticide Programs has, as we explained  
6                   earlier, we want to do more realistic kind of scenario. But we  
7                   couldn't do all of these kind of scenarios.

8                   So we certainly will look into your recommendation as  
9                   a whole, how we do the -- the approach of the Office of Pesticide  
10                  Programs is more deterministic at this time. And so you can do  
11                  more, you know, default assumptions, so it's more public health  
12                  concern to see whether there is risk or not, or you do more realistic  
13                  and probabilistic.

14                 So these are the options we are looking at. So I really  
15                 think that the panel needs to recommend, with regard to this issue,  
16                 given the best available information, given the fact that we will  
17                 need to support more additional research, what will be the best  
18                 approach given the available information.

19                 DR. ROBERTS: Dr. Kissel?

20                 DR. KISSEL: I just wanted to, I think, endorse Gary's  
21                 comment that maybe we should go with 50 percent here.



1                   I view this -- there is an incredible disconnect here  
2   between this discussion and the way you are doing the risk  
3   assessment which is to multiply five numbers together that are  
4   point estimates, which is extraordinarily primitive.

5                   And under those circumstances, really getting all the  
6   nuances is -- it just doesn't match up.

7                   And given that much of the argument here is about  
8   relative bioavailability in soil, when we don't even know that  
9   what's under these things is soil because there is the bark and the  
10   pea gravel and other sorts of things, that it makes the uncertainty  
11   very large. And so I would be inclined to just take a stab at 50 --  
12   if you are going to do one of these back-of-the-envelope things,  
13   guess 50 percent and run with it.

14                  Otherwise, I think what this points out is that you want  
15   to go to a probabilistic assessment. And one of the ways that you  
16   can deal with that is that you take variability from individual  
17   studies and you take uncertainty by incorporating all the studies  
18   by picking randomly among the available studies. And what you  
19   wind up with is very large error bars which then you have to decide  
20   what to do with. Where are you going to regulate out there in  
21   those upper percentiles?

1                   But that's really where you need to go because there's  
2                   limited returns to try to refine a parameter if you are just going to  
3                   multiply five numbers together and say that's a risk assessment.

4                   That's probably question 8, but --

5                   DR. ROBERTS: Dr. Clewell?

6                   DR. CLEWELL: For the record, I came in at 25 to 50,  
7                   splitting the difference being around 35 to 40, Vanessa. And I  
8                   agree with what John said, 100 percent.

9                   But the only way to get around this -- you are going to  
10                  have the same problem with the residue levels on the wood. You  
11                  know, what's the number? Well, there isn't a number; there's lots  
12                  of numbers.

13                 So it's going to be difficult to escape the rush to the  
14                 probabilistic risk assessment, which we'll get to later. But for  
15                 now, if you have to have a number, I'm happy with 50 percent, 40  
16                 percent, whatever you want, as long as we can get some sense of  
17                 consensus. I believe we really do need to give them a number.

18                 DR. ROBERTS: Dr. Styblo.

19                 DR. STYBLO: I think I'm coming to agreement with  
20                 two previous speakers. Saying so, I would like to ask a question.  
21                 Is there any mechanism we can trigger that would bind the agency

1 to launch studies, experimental studies with appropriate design  
2 that would come with some corrections, because I'm really scared  
3 here? I'm in exact science and we are far from that now.

4 So is there anything we can not just recommend, but  
5 really get certain level of certainty that, in two years, you know,  
6 in latest term, we get better numbers from better experiments?

7 DR. ROBERTS: I think the answer is probably no.

8 DR. STYBLO: That will make it difficult for me then.

9 DR. ROBERTS: I think the panel can certainly  
10 strongly recommend, urgently recommend. Beyond that, I don't  
11 know that we have any ability to compel the agency. We're an  
12 advisory body.

13 Dr. Heeringa and then Dr. Mushak.

14 DR. HEERINGA: Just a quick comment on this. I  
15 appreciate the scientific discussion here, but as was pointed out by  
16 John on the path here, that we're talking about a factor that, at  
17 maximum, can have sort of a four-fold variability within the  
18 ranges that we have observed. And if we set it within the context  
19 of the ranges we were discussing, it may be two-fold variability.

20 And as I look down the path to the composite risk  
21 assessment, if I could get something down to two to one

1 variability, I would be very, very happy.

2                   So I think it's very important to carry that out. But in  
3 terms of the overall exposure and looking at the components of  
4 this composite risk assessment, that ultimately, this is probably  
5 not going to be the parameter that's going to drive the outcome.

6                   DR. ROBERTS: Good point.

7                   Dr. Mushak?

8                   DR. MUSHAK: If we look at the fact that two soils  
9 tested by two animal models suggest a range from, say, 25 --  
10 whatever the set of conditions -- and 42 as an UCL in the pig  
11 model, and if we take Gary's caveat about there are media out there  
12 that are probably going to release arsenic much more avidly than  
13 soils, then I think 50 percent is quite scientifically reasonable as a  
14 first stab. I think also this would accommodate the children issue.

15                   And I think -- let me just briefly point out that one  
16 problem with trying to say that there may not be any difference,  
17 children versus adults with arsenic, is that -- you know, one of the  
18 reasons that kids do differ from adults with metals -- and, again,  
19 Dr. Clewell, I appreciate the basic chemical difference between a  
20 metalloid and a metal -- is the fact that, you know, one of the  
21 reasons why children, in fact, show higher uptake rates are these

1       nutritional deficiencies. And one basic nutritional deficiency in a  
2       lot of children is phosphate.

3                       So to the extent that an arsenate/arsenite partakes of  
4       phosphate pathways in any fashion, this is a nutritional connection  
5       that defines a developmental parameter. So I would say 50 percent  
6       is scientifically reasonable.

7                       DR. ROBERTS: Again, recusing myself from this, but  
8       we seem to be approaching a consensus of 50 percent.

9                       Is that -- without taking a vote, but looking at heads  
10      sort of nodding or shaking their head, would that be a reasonable  
11      consensus recommendation from the panel on this, and that we  
12      would move on to the next question?

13                      Dr. Vu, do you have any questions that fall upon our  
14      feedback on this particular --

15                      DR. VU: I don't think the agency has any questions.  
16      Thank you.

17                      DR. ROBERTS: Great. Let's go ahead and tackle the  
18      next question while we're on the subject of absorption.

19                      Can you pose the next question to the panel.

20                      DR. McMAHON: Yes. Thank you.

21                      Our next question deals with the dermal absorption

1 value for inorganic arsenic. And as you have seen, we have  
2 selected or proposed a value of 6.4 percent based on the data of  
3 Wester in 1993.

4 Our question to the panel is to please comment on the  
5 selection of the value of 6.4 percent for dermal absorption of  
6 inorganic arsenic and whether or not this value will be appropriate  
7 for use in all scenarios involving dermal exposure to arsenic from  
8 CCA-treated wood, including children's dermal contact with wood  
9 surface residues and contaminated soils.

10 DR. ROBERTS: Dr. Bates, what do you think about  
11 6.4?

12 DR. BATES: Well, if we think that -- oral  
13 bioavailability is a difficult thing to assess. I think dermal  
14 bioavailability is perhaps an order of magnitude worse. However,  
15 I'll do my best, again, being a non-expert on this area.

16 As Dr. Kosnett pointed out for oral bioavailability,  
17 there are many factors that influence it, and that's definitely the  
18 case for dermal bioavailability.

19 Factors such as the concentration on the skin or in the  
20 mass of material on the skin, pH, the moisture content,  
21 temperature, chemical form of the substance, degree of fat or

1 water solubility, the matrices, including the particle size and so  
2 on, they all influence the degree of dermal bioavailability.

3 Now, for the purposes of this assessment, of necessity,  
4 I have relied on the study which has been selected by the EPA by  
5 Wester, et al., published in 1993. I haven't had the opportunity to  
6 do an independent literature research and see if there are any other  
7 studies. I assume the EPA has done that and zeroed in on this  
8 particular study.

9 It was useful to read the study, and perhaps I'll just  
10 summarize some of the key aspects.

11 The study involved female rhesus monkeys. There  
12 were groups of three and four. I'm not quite clear whether those  
13 were separate monkeys, but I'm assuming there were seven  
14 different monkeys.

15 They were administered H3 AS04. Now, I'm not sure  
16 what the actual name of that chemical is, but it's clearly  
17 pentavalent. And this was administered in two ways: As a water  
18 solution and after adding it to soil.

19 And for both the water solution and the soil solution,  
20 they administered in a low dose and a high dose, so there were two  
21 dose groups.

1                   Now, the low-dose group was -- the low-dose amount  
2                   was described in the paper as the minimum arsenic that could be  
3                   used given the specific activity of the compound, so they used  
4                   radio-labeled arsenic for this investigation. And they said this  
5                   represents general background arsenic.

6                   And the high dose is representative of what would be  
7                   encountered in more contaminated areas. And, as I said, the  
8                   higher dose is also equal in mass to other compounds  
9                   experimentally dosed on skin, and this can be used for comparative  
10                  purposes.

11                  The low trace dose gave an arsenic skin concentration  
12                  of 0.00004 micrograms per centimeter and the high dose was 0.6  
13                  micrograms per square centimeter, so there was the quite a  
14                  difference between the two.

15                  The results show an apparently anomalous result that  
16                  the -- well, perhaps it's not anomalous. But the low-dose  
17                  absorption was higher both for water and for soil than the  
18                  high-dose absorption. And the EPA had selected the value of 6.4  
19                  bioavailability for the low dose in water.

20                  The perhaps difficult to explain situation was that the  
21                  water -- for the soil, the corresponding low-dose value was 4.5



1     percent. However, for the high-dose water, there was 2 percent,  
2     and for the high-dose soil, it was 3.2 percent, which raised the  
3     anomalous situation that, with soil, there was a greater degree of  
4     absorption than from water itself, which was perhaps what lead the  
5     EPA to choose the value of 6.4 percent for the low-dose water  
6     exposure.

7                 Now, from basic toxicological principles, I would have  
8     said that it would be more appropriate to rely on the high-dose  
9     exposures because these are more consistent with what one would  
10    expect in a real life situation. However, we're left with the result  
11    that soil appears to be more bioavailable than water itself.

12                So there are two ways -- two possible explanations for  
13    that. It could be that there is some factor in the soil which  
14    actually promotes bioavailability.

15                The alternative explanation is that this is a small  
16    numbers problem and that what we're experiencing here is the  
17    result of just random biological variation. And I suspect that  
18    that's really what has happened. And that has lead to the soil  
19    high-dose value being more bioavailable than the high-dose water  
20    value.

21                And I think that that also explains where the Superfund

1 program got their value of 3 percent. It was pointed out yesterday  
2 by Dr. Benson that there was a discrepancy that the Superfund  
3 program was using 3 percent, which is very close to that high-dose  
4 soil value here of 3.2 percent. So I think that possibly explains  
5 the discrepancy between the two values.

6 So what I would say, on the basis of toxicological  
7 principles, is it would be better to go for the high-dose value,  
8 which is more representative of a real exposure situation, and also  
9 means making a decision between the soil and the water values.  
10 And I think probably the soil value of 3.2 percent is the most  
11 appropriate there, and it does correspond very much with the  
12 Superfund value of 3 percent.

13 So if I had to pick a number, I would lean towards the  
14 3.2 rather than the 6.4 percent.

15 I also would like to point out that a couple of the  
16 public commenters, I think Exponent and Gradient, have suggested  
17 multiplying the value from Wester, et al., by another factor which  
18 represents the oral bioavailability to take into account the fact  
19 that, in this study, they didn't use the arsenic from CCA; they used  
20 a more water-soluble value, which may, in fact, lead to a more --  
21 to a higher bioavailability than you would expect in reality.

1                   However, my problem with that is that appears to be, to  
2                   some extent, double counting factors in the soil, which would tend  
3                   to retard bioavailability, so you've got them on the skin, you've  
4                   got them in the gut, and I don't think it's necessarily appropriate to  
5                   multiply those two together.

6                   So taking all this into account, I think probably the  
7                   most appropriate value to use is the 3.2 percent bioavailability for  
8                   the high-dose soil.

9                   However, having said that, I think it's clear that there  
10                  are limited data here and they are using a type of arsenic which is  
11                  not the same as in the CCA. On the other hand, it is probably --  
12                  my suspicion is probably more water-soluble and bioavailable in  
13                  this instance, so it's probably overestimating the true value.

14                  So weighing all these things up, I would lean towards a  
15                  value of 3.2 percent as being more appropriate than 6.4.

16                  DR. ROBERTS: Thank you, Dr. Bates.

17                  Dr. Hopenhayn-Rich, what is your number?

18                  DR. HOPENHAYN-RICH: I'm not going to propose or  
19                  endorse any specific number.

20                  I think that Dr. Bates has covered most of the issues  
21                  that I was going comment on. I will just sort of reiterate the fact

1     that I do think that there is definitely a small number issue here  
2     that could explain the differences between the high and low dose  
3     and between the soil and the water, so that effectively probably  
4     none of these numbers are significantly different from each other.

5             If you play around with the confidence intervals, you  
6     could come out with the low-dose water being lower than the  
7     high-dose water and et cetera.

8             But I am concerned about, besides the small number  
9     issue of the design of the study, the fact that just one arsenic  
10    compound was used instead of CCA, which seems to be the  
11    compound, obviously, of interest here and that we are supposed to  
12    be making decisions on. And I'm not sure, again, how much we can  
13    recommend further studies being done to address this problem.

14            And also the issue of the type of soil that was used and,  
15    as was mentioned below, the fact that this was not aged soil but  
16    freshly impregnated soil with the arsenic compound.

17            So I'm not ready to endorse the 6.4 of the 3.2.

18            If I had to pick a number, though, I think I would go  
19    with the more conservative assumption, based on all the  
20    uncertainties, again, on the worst case scenario of 6.4. So maybe I  
21    have chosen a number.

1 DR. ROBERTS: I wrote it down.

2 Dr. Kosnett?

3 DR. KOSNETT: I agree with Michael that if we think  
4 that the data set is limited with respect to oral bioavailability, we  
5 have even a tougher problem with the lack of a lot of data with the  
6 skin issue.

7 One issue I don't know if you mentioned, Michael, but  
8 I think we have to bear in mind that in this particular study by  
9 Wester, the had prolonged contact. Did you mention that?

10 DR. BATES: No, I didn't, but that is a good point.

11 DR. KOSNETT: The way the study was designed, the  
12 soil and water were held in continuous contact with the skin for 24  
13 hours, which could conceivably -- there could be conceivably a  
14 situation where the soil would be held in contact directly with a  
15 child's skin for that period of time, but it probably -- on most of  
16 the situations, it might not stay in contact for that long and that  
17 could have influenced the results here in the direction of  
18 increasing absorption.

19 And with that said, you know, I don't think that -- I  
20 don't feel strongly about taking one number over the other.

21 There's actually four values that are given in this paper, anywhere

1 from 2 percent to 6.4 percent. And maybe it would be safe to split  
2 the difference and note the range or something like that.

3 But I guess I would make the -- I would probably say  
4 that, you know, what EPA should do is consider a range approach.  
5 Considering the limitations of the data, that's always the safest  
6 things to do. It may be small factor overall in the decisions that  
7 are ultimately made, but with the lack of uncertainty, that's  
8 sometime -- I mean, the lack of certainty, that's sometimes the way  
9 to go.

10 And I would also make a call, as I think most people  
11 could endorse, for prompt and urgent research in this area.

12 DR. ROBERTS: So a range?

13 DR. KOSNETT: Yeah.

14 DR. ROBERTS: I won't pin you down any more.

15 Other comments?

16 Dr. Thrall?

17 DR. THRALL: I would just recommend that when you  
18 are guessing, that you not go beyond a decimal point. It implies  
19 that you are not guessing.

20 DR. ROBERTS: Well stated, Dr. Thrall.

21 I might as well jump in on this one, too.

1                    Basically, I think it is a small number kind of thing. I  
2                    think all of these things are essentially equivalent. And probably  
3                    because of the way the study was done with soil and it was added  
4                    without a chance for much interaction with the soil matrix, you are  
5                    really probably measuring the dermal bioavailability of soluble  
6                    arsenic applied to the skin.

7                    So there is the question of had the arsenic had an  
8                    opportunity to interact with soil, how much reduction would there  
9                    be?

10                   And I don't think there is any data to address that. I  
11                   know that one of the public commenters tried to make a shot at it,  
12                   but I agree with one of the previous comments that I just don't  
13                   know that there is a sound scientific basis for using that number.

14                   So I don't think we have any data. I think we can look  
15                   at these numbers, though, as being probably conservative because  
16                   that interaction hasn't been taken hasn't taken place.

17                   And that would tend to make me want to pick a number  
18                   more in the middle like 3 or 3.2 than maybe one at the upper end.  
19                   Those are just my thoughts.

20                   Dr. Styblo?

21                   DR. STYBLO: Let me give you an additional piece of

1 information to consider.

2 This comes from experiments, in vitro experiments  
3 done in Dr. Hughes' lab in research triangle park some time ago,  
4 and it's about arsenic species, again, because that's my specialty  
5 here.

6 He did in vitro experiments using skin removed from  
7 mice and tested the dermal absorption of arsenate pentavalent  
8 methyl and pentavalent dimethyl arsenic. They are unique data  
9 considering that nobody else did the other species.

10 If you look at the absorption rates and compare them  
11 between these three species, you come with a rough conclusion  
12 that arsenate permeation are three to four times higher than those  
13 for methyl arsenic 5 and about two times higher than for dimethyl  
14 arsenic 5.

15 An interesting issue for methyl arsenic is that there is  
16 a significant portion that stays absorbed in the skin. It doesn't get  
17 through the skin to a vehicle, to the medium that is below the skin,  
18 which could be an interesting point for dermal toxicity.

19 So using just this data in very rough estimation, if  
20 there are any other species, methylated species present in our  
21 samples and if they are in pentavalent form, the bioavailability



1 would be rather lower than greater, although I would like to point  
2 out, we don't know much about dermal absorption of trivalent  
3 arsenic. And something I just asked Michael and I will ask other  
4 people: Is anybody familiar with data on dermal absorption of  
5 trivalent arsenic, obviously inorganic? Nobody did anything else?  
6 Are there any data out there?

7 DR. ROBERTS: Dr. Kosnett, are you aware of some  
8 data?

9 DR. KOSNETT: One thing that -- it's unfortunately  
10 not, in a sense, as quantitative as we would like. But one thing  
11 that we should bear in mind is that there is some experience with  
12 people bathing frequently in high arsenic waters and then having  
13 their urinary arsenic examined.

14 There is one particular study of which I only have the  
15 abstract, but it was performed in the Japanese Journal of Hygiene  
16 in 1978, and it involved a health examination on two subjects --  
17 excuse me -- seven subjects, two males and five females who used  
18 arsenic-containing hot water from the geothermal power station in  
19 Kyosho (ph), Japan. They used the hot water to take only a bath  
20 for four years. The arsenic concentration in the water was 3,530  
21 micrograms per liter. So it's pretty high.

1                   And they did an evaluation in which they measured  
2   arsenic concentration in the urine three times per day for each  
3   subject. And they said it was in the normal range for Japanese,  
4   which was 58 to 178 micrograms per liter total arsenic, bearing in  
5   mind, too, that the Japanese with the fish diet, that it is  
6   considerably higher than it is in the United States.

7                   So, I mean, their essential finding there was that even  
8   though these people were bathing in this very high arsenic water,  
9   they did not have a massively -- you know, they didn't have a  
10   detectably elevated arsenic excretion in the urine with the urine  
11   being measured three times during the day.

12                  I don't have the full study, and perhaps it would  
13   behoove the agency to obtain the full translation and any further  
14   follow-up studies that had been done.

15                  I think Dr. Smith mentioned the other day that there  
16   is -- he and I have discussed -- Dr. Smith is doing and should  
17   comment on, if you would, on the study that you are going to  
18   examine about bathing because that might --

19                  DR. ROBERTS: Let me get to -- let me let Dr. Styblo  
20   complete his comments and then we'll go around and then maybe  
21   Dr. Smith can fill us in.

1 DR. STYBLO: Well, I just want to make one  
2 conclusion. If pentavalent arsenicals are present in the  
3 environment, the bioavailability of the overall amount of arsenic  
4 would be rather lower than that for simply arsenate from aqueous  
5 solution.

6 Again, the uncertainty is, are there any trivalent  
7 arsenicals present.

8 DR. ROBERTS: And did you want -- since you are  
9 speaking, did you want to venture anything on this particular  
10 question?

11 DR. STYBLO: No.

12 DR. ROBERTS: Fair enough.

13 Dr. Freeman, then Dr. Kissel.

14 DR. FREEMAN: I would like to go back to this idea  
15 from the study that you are sticking this moist material onto the  
16 skin for 24 hours. This is not what would be happening to children  
17 under this scenario of playing in a -- one of these jungle gyms.

18 They may have contact on the skin, presumably with  
19 something which we might characterize as a dislodgeable residue  
20 in which there is arsenic.

21 Because it is dislodgeable from the play place or the

1 soil, it may also dislodge from the skin after some period of time.  
2 And so to assume that you have reasonably high uptake dermally  
3 for this metal when no other metals seem to behave like this, other  
4 than for maybe mercury, doesn't make an awful lot of sense to me.  
5 So I would choose a low number rather than a high number. What  
6 low number?

7 DR. ROBERTS: If you are willing to venture a  
8 recommendation.

9 DR. FREEMAN: 2 or 3.

10 DR. ROBERTS: 2 or 3. Okay.

11 Dr. Kissel?

12 DR. KISSEL: Yes. I'm actually somebody who has  
13 done some dermal absorption work, although not in vivo, and so I  
14 have probably more to say about this protocol. But first I wanted  
15 to say this notion of a fixed percent absorption is nonsensical.

16 We're taking the gastrointestinal model and applying it  
17 to dermal which -- in the gastrointestinal tract, there is some  
18 normal kind of retention time in the population, so it flushes  
19 through and you report that because people are doing experiments  
20 in one species where there is some kind of normal retention period.

21 In soil, there is no normal retention period. We don't

1 know what that is. If you leave soil on the skin forever and there  
2 is a positive thermodynamic gradient from soil to skin, the  
3 chemical agent will be absorbed forever.

4 Obviously, that doesn't happen in the real world. What  
5 we're talking about here are probably several-hour kind of  
6 exposures, maybe from a few minutes, if somebody washes  
7 promptly, to several hours if they don't.

8 But taking 24-hour numbers and then applying them to  
9 short-term or what we think are probably shorter term experiments  
10 or actual exposure is out of whack with trying to do good risk  
11 assessment.

12 And dermal doesn't often show up as very important,  
13 and so people don't care too much, and so they are happy to do  
14 things kind of sloppily, but this notion that you just take this  
15 24-hour number and apply it, regardless of whether the child  
16 touched the swing set playing tag and then ran into the house and  
17 washed his hands is the same as if the kid went out and played on  
18 the thing all day and then went to bed without taking a shower or  
19 bathing and slept in the accumulated dirt for 24 hours -- that you  
20 would get exactly the same uptake is just not very plausible.

21 So I would strongly urge EPA to start thinking of a

1 better way to model dermal absorption, and I really think you  
2 ought to be doing this as a rate with consideration of variable time  
3 periods of exposure. So that's kind of point number 1.

4                   Then I have a problem with how these experiments are  
5 done. We're trying to model some kind of an exposure where  
6 somebody gets dirt on their skin and it stays on there for a while.  
7 There is argument about whether we should deal with static versus  
8 dynamic exposures where you might rub the soil into the skin  
9 using kind of pressure which probably applies to hands and maybe  
10 knees, but wouldn't apply to foreheads and other parts of the body  
11 that you don't normally rub against things strenuously. But it's  
12 mostly a static kind of experiment.

13                   Now, in order to do this in vivo -- and there is a  
14 prejudice among toxicologists that in vivo is better than in vitro  
15 because of clearance limitation and other sorts of things, and  
16 mystery things that go on in organisms that don't happen in vitro,  
17 and so you want to do in vivo work. But there is a trade-off here  
18 that in order to get an organism in vivo, we have to do something  
19 very strange with the dirt here, which is to put it on the outside of  
20 the skin and then somehow figure out how to keep it there while  
21 the animal is then alive for the exposure period.

1                   And what Wester and his group do is anesthetize the  
2   animal, lay it down flat, apply the stuff, I suspect, while it's still  
3   moist. This is another gripe is that they never describe actually  
4   how they put the stuff on the skin or adequately describe how they  
5   put it on the skin or the time period and the contact between the  
6   agent and the soil when they put it on the skin -- it's probably still  
7   damp.

8                   And one of the reasons you might expect that you get  
9   the same uptake from water and soil is that, in fact, what you have  
10   is a water application in one case and a water mixed with dirt  
11   application in the second case, in which case it's really just  
12   absorption from water in both cases, and that might be going on.

13                  So they put the stuff on the animal while it's  
14   anesthetized and then they cover it with two aluminum eye patches  
15   which makes a little dome over the top with a Gortex sandwich in  
16   between, and then they tape that down.

17                  Well, then the monkey sits back up.

18                  Another criticism of the Wester work is that they have  
19   used a large particle size which allows them to avoid dust in their  
20   laboratory. I think that one way to avoid dust in the laboratory is  
21   do the work in a hood. If you are worried about exposing your

1 people to dust, then you use what is an abnormally large soil size.  
2 They are using 180 to 300-micron soil particles, which is much  
3 larger than the soil that would actually stick to skin if you had a  
4 real exposure.

5                   So now you have taken this monkey and you sit it up  
6 and you have huge soil particles. My hunch is that it falls down  
7 into the bottom of the space under this concave kind of device.  
8 Now, I don't know what that is.

9                   What exposure are we modeling there? I mean, in order  
10 to get an in vivo application, we have created this thing where a  
11 child has a cup of soil taped to its side and is sitting, in this case,  
12 in a restrained chair -- somebody else has done these experiments  
13 where they allow the monkey free range, which means that the  
14 think is shaking around in there and you're shaking dirt on the  
15 outside of the monkey instead of having a layer of dirt on the skin.  
16 And it gets to be kind of a strained scenario to say that that's  
17 indicative of what happens to a real person in a real exposure. So I  
18 don't have too much confidence in what's going on here.

19                   On top of that, if you read the paper, you won't see  
20 much cognizance of environmental chemistry. The water in which  
21 the stuff is dissolved is not even described.



1                   When you are dealing with inorganic compounds,  
2     partitioning among phases has a lot to do with what else is in the  
3     water with the ion that you're interested in. If you don't describe  
4     anything about the water quality, it makes it kind of difficult to  
5     understand what's going on because you don't know the speciation  
6     of the agent that you are interested in. And they compare, as if  
7     they were directly comparable, the arsenic acid which is applied to  
8     the monkey and some separate partitioning experiments which  
9     they've done, which were done with arsenic chloride as if arsenic  
10    is arsenic and it doesn't matter what complimentary ions might be  
11    in the solution with it. That doesn't inspire confidence.

12                  There is also a history of other work done by this same  
13    group where they have reported the same absorption for organic  
14    compounds, statistically indistinguishable absorption from  
15    organic solvent, which is then evaporated on the skin, so pure  
16    compound and stuff loaded on soil.

17                  Now, you can either believe that the thermodynamic  
18    activity of organic compounds like PCBs and pentachlorophenol  
19    on soil are the same as the thermodynamic activity of the pure  
20    compound or you can believe that the experiment was done in a  
21    way which doesn't allow you to distinguish between things that are

1 obviously different.

2                   Given that context, I'm very nervous about accepting  
3 any specific recommendations with respect to this work.

4                   Also not described in here is anything about cage wash,  
5 whether anything could escape from this. You know, does the tape  
6 peel up? Does anything get out? Is that being counted? Is that  
7 why you get big numbers? I don't know. It's not described.

8                   Normally, you like to know what's going on if you are  
9 going to evaluate stuff, and work from that group is remarkably  
10 sparse in terms of description of environmental details.

11                  With respect to the monkeys, my understanding is that  
12 there were not seven monkeys. I think the total colony that they  
13 were dealing with -- and I could be wrong on this -- but from  
14 conversations, I think they have never had more than five or four  
15 or five monkeys. So this is repetitive use of monkeys and there is  
16 a question of sequencing. Was the low-dose soil before the  
17 low-dose water, before the high-dose soil, before the high-dose  
18 water, or was it some other sequence and could we just be seeing  
19 slow leaking from monkeys that's confounding results from  
20 different -- I don't know. And maybe they thought about that and  
21 did it right, but they certainly didn't tell us that they thought about

1 it and did it right.

2 I notice that if you take the flux to concentration ratio,  
3 for soil it's uniformly about 10 times higher than the flux to  
4 concentration ratio for water, which actually argues against my  
5 argument that it's the same experiment in both cases and just adds  
6 to my general puzzlement about what the hell is going on here.

7 And I would also like to point out that there are not  
8 four numbers here, there are six numbers, because there were some  
9 in vitro experiments done also, and they tend to be -- the water  
10 number is the same as the high-dose water and the soil number  
11 tends to be a little lower.

12 For an inorganic compound, I think the clearance  
13 limitation thing probably wouldn't apply, or it might not, anyway.  
14 You have to check the solubility kind of considerations.

15 In this case, the in vitro numbers might be just as good  
16 as the in vivo numbers. At least with the in vitro numbers, you  
17 know that the stuff was sitting flat on a horizontal surface on the  
18 skin for the 24-hour period, and you can then draw some  
19 interpretations about that, whereas in the in vivo case, you had  
20 stuff lumped at the bottom of this protective device.

21 So, overall, the results are counterintuitive that

1 availability from soil would be greater than availability from  
2 water.

3 I would be inclined to take the lower soil number,  
4 either 1 percent from the in vitro work or 3 percent from the soil  
5 work, and divide it by 24 hours and say that maybe .1 percent per  
6 hour is a number that you could use, and then modify that further  
7 with some estimate of how long somebody is actually going to be  
8 in contact with soil.

9 Certainly, I want to endorse the comment that two  
10 significant figures here is not justifiable.

11 DR. ROBERTS: Dr. Kissel, I just have a follow-up  
12 question for you.

13 When you say to divide by 24, so you would assume  
14 that the flux is linear? I mean, it's a zero order process?

15 DR. KISSEL: Well, it's probably not. You actually  
16 expect it to be more rapid, initially. But since I think these  
17 numbers are probably too high, anyway, it doesn't bother me too  
18 much that linearizing would kind of undercut what the actual shape  
19 of the curve was.

20 In another case, I might want to use -- linearize  
21 something over a shorter time period, not take the 24-hour number

1 and linearize it, but take a four-number and linearize that.

2 DR. ROBERTS: Let me ask a follow-up question since  
3 you recommended a different approach and seemed to encourage a  
4 flux model rather than just a straight percentage, I think for some  
5 good and logical reasons. Are there any flex data for arsenic or  
6 arsenic from soils, if they decided to go that approach instead of  
7 picking a percentage that they could use?

8 DR. KISSEL: The current EPA document has got a KP  
9 calculator for inorganics in general, which is probably too high by  
10 a couple of orders of magnitude.

11 For inorganics, we're really in bad shape. Actually, for  
12 organics, we're really in bad -- for anything from soil, we're in  
13 really bad shape in the dermal world. The existing database is  
14 grossly inadequate to what it's being used for.

15 DR. ROBERTS: I just wanted to be clear that  
16 basically -- and I would agree; I think this is direction they need to  
17 go, but perhaps the data aren't there in the immediate term for  
18 them to use this approach.

19 DR. KISSEL: Which is why you could take these  
20 numbers -- and I think they are going to be conservative and I  
21 think the dermal pathway is going to be more impacted by an

1 adjustment I'm going to recommend to the soil loading number that  
2 they are using, so it's going to get knocked down a lot anyway.

3 DR. ROBERTS: Other comments?

4 Dr. Smith, then Dr. Francois.

5 DR. SMITH: I think this may be directed to Dr. Kissel,  
6 but I'm looking for some clarification here because we have two,  
7 as I understand it, dermal exposure scenarios. One is going to be  
8 the one associated with soil loading onto the skin from children  
9 playing around the structure; the other is going to be the  
10 dislodgeable arsenic.

11 Many of the concerns I just heard you voice I felt were  
12 directed more to issues around the soil issue. Can you tell me or  
13 talk to us a little bit about your thoughts of to what extent your  
14 concerns apply to the dislodgeable arsenic that's going to be on  
15 hand surfaces. I mean, would you still recommend the same  
16 approach? Do you still have all the same concerns?

17 DR. KISSEL: You are right, I was talking about soil.  
18 And that does create the problem of what do we do with the  
19 dislodgeable residue. And I don't actually know what the  
20 bioavailability -- it would be hard to even put an order of  
21 magnitude kind of guess, although I'm sure it's a lot less than 100

1 percent. But pure inorganic compound on the skin, I'm not sure  
2 what to do with that.

3 DR. ROBERTS: Dr. Smith.

4 DR. SMITH: I just wanted to follow up on --  
5 Dr. Kosnett made a comment and I just wanted to respond to it.

6 First, I'm not going to talk about the work that we're  
7 doing, only because I don't think it's going to be available for a  
8 year or two. It's also something that has much more to do with  
9 children's behavior than really a dermal study, per se. But if  
10 anyone wants to talk about it, I'll be delighted to talk about it.

11 What I do want to comment on is my awareness is that  
12 there is a study with rats, I believe, where the tail is left in the  
13 beaker for a period of time to measure sort of dermal uptake. And  
14 that if you measured the blood arsenic concentrations over the  
15 seven days following, it remained high, is my recollection, over  
16 the entire seven-day period.

17 So I'm just saying that I would have concerns about the  
18 sort of study design with the Japanese you mentioned where they  
19 just happened to look at urine levels for that day for dermal  
20 exposure and conclude, therefore, that there can't be much dermal  
21 uptake. And you and I have talked about the Alaska data, how

1       that's open to interpretation.

2                       DR. ROBERTS: Thank you.

3                       Dr. Francois?

4                       DR. FRANCOIS: I don't mean to confuse the issue any  
5       further, but I just wanted to remind the panel that skin  
6       permeability in humans varies depending on the site of the body  
7       that you are looking at.

8                       DR. ROBERTS: Thank you, Dr. Francois.

9                       Dr. Morry?

10                      DR. MORRY: Just a quick comment with regard to the  
11       exposure of the skin to the dislodgeable stuff from contact --  
12       direct contact with the wood. It seems to me that we can't say  
13       whether we're talking about an inorganic compound on the skin or  
14       what medium the compound is going to be in because the wood is  
15       going to be covered with dew or rain or not, it's going to be dry.  
16       And the skin is either going to be sweaty or not sweaty or covered  
17       with part of lunch or something like that.

18                      So, you know, who knows what the medium is going to  
19       be for that exposure.

20                      DR. ROBERTS: Dr. Kissel?

21                      DR. KISSEL: If I could add something to that. One of



1 the things that -- normally, when you think about exposure to  
2 water for dermal absorption, a lot of the experiments are done in  
3 diffusion cells where you have liquid water sitting on top of stuff  
4 and there is liquid water sitting there the whole time. And you  
5 calculate a -- you leave it long enough to get steady state and you  
6 do a permeability coefficient, and that's kind of a standard  
7 approach. This is actually five microliters of water applied to the  
8 skin and that's how much water there is. I don't know of what  
9 happened subsequently in the experiment.

10                   Could that much water be absorbed into the skin so  
11 that, effectively, the inorganic salts are left as deposit on the  
12 skin? I don't know.

13                   Would it run off when you sat the monkey up like I  
14 would expect the dirt to run off? I don't know.

15                   So there is at least a possibility that the water numbers  
16 here are not too far off for having placed arsenical salts directly  
17 on the skin and left them.

18                   But this is all shot in the dark kind of stuff. Because  
19 the experiments just aren't done in a way that's helpful to the  
20 question.

21                   DR. ROBERTS: The limitations in the studies, I think,

1 have been well discussed here. And, also, I think it's fair to say  
2 that the situation is not going to get any better any time soon  
3 because of the problems that Dr. Kissel pointed out, and I would  
4 echo those. And there are a lot of difficulties in conducting  
5 in vivo studies.

6 In vitro studies are easier to conduct, but then there is  
7 always this issue of interpretation and that sort of thing.

8 Let's get back to the question.

9 Is 6.4 percent an appropriate value to use for the  
10 scenarios under discussion? And, if not, what value would this  
11 panel recommend? Is there a consensus value that this panel  
12 would recommend? Or what are we going to tell the agency to do?

13 Dr. Clewell?

14 DR. CLEWELL: I think that there have been a number  
15 of points made about why these are probably conservative values  
16 that have been provided in the study.

17 And John's point in particular is important about these  
18 being 24-hour occluded values and we're talking about much less  
19 than 24-hour retention on the skin for almost all children who have  
20 a mother.

21 So I think that we certainly would want to use one of

1 the more conservative -- one of the lower values from this study.  
2 And since the high dose values are 3 percent and 2 percent for  
3 water -- for soil and water respectively, as Dr. Thrall pointed out,  
4 2 to 3 percent sounds good to me.

5 DR. ROBERTS: Dr. Kosnett. I want this to be a pretty  
6 numerical discussion.

7 DR. KOSNETT: I just had one question to ask, and I  
8 don't know if Dr. Beck is in the audience, but I read her comments  
9 that were submitted. And it's interesting, she references a study  
10 by Peebles -- and this is in the gradient comment book.

11 There is a study that's referenced, but the numbers  
12 aren't given. It's called the Dermal Absorption of Arsenic in Dogs  
13 from Sawdust From Wood Treated with ACA and CCA-C,  
14 University of California School of Veterinary Medicine,  
15 Department of Physiologic Science, Davis, California.

16 Do we have --

17 DR. ROBERTS: I believe those data were presented in  
18 the public comments, but I don't know if we have -- Dr. Beck is --

19 DR. BECK: I have to go back and look at the study. I  
20 do recall they didn't see any toxicological effects with the dermal  
21 studies, but I don't recall what was seen on the absorption,

1 specifically, and I'm wondering if John Butala is in the audience.

2 John, do you recall results from the Peeples study  
3 with --

4 DR. ROBERTS: Very quickly, Dr. Butala.

5 MR. BUTALA: I described those studies to you  
6 yesterday. We do have copies of the actual study report for you  
7 today. I think they are being photocopied as we speak.  
8 Specifically, your question was what?

9 DR. KOSNETT: I didn't see -- there was no  
10 quantitation given in the gradient submission. I just wondered  
11 what was the percent uptake that was observed.

12 MR. BUTALA: From that particular study, there was --  
13 as you recall, there was a measurement made prior to the -- these  
14 were urinary concentrations of arsenic.

15 There was a measurement made prior to the dermal  
16 administration because the dogs were known to have about 135  
17 milligrams per day dietary arsenic. And that was -- and I don't  
18 recall what the urinary concentration was, but I remember what I  
19 said yesterday.

20 Whatever the predermal dosing urinary concentration  
21 was of arsenic based on the 135 milligrams dietary exposure, the

1 administration of CCA-treated wood sawdust to the skin for two  
2 days and then for four days after --

3 DR. ROBERTS: I'm sorry. I don't mean to -- are the  
4 data adequate to develop an estimate of bioavailability?

5 MR. BUTALA: Well, there was zero increase in the  
6 urinary arsenic following dermal administration of sawdust.

7 DR. STEINBERG: It was a non-referenced article.  
8 There was no reference to this, so I don't know how this could be  
9 admissible. And I hate to see us get distracted on these tangents.

10 DR. ROBERTS: Let's let that sit for a second.

11 Let me ask, again, the panel: Does anyone have an  
12 opinion about -- that hasn't weighed in yet -- about 6.4 percent? Is  
13 that an appropriate value or should the panel -- what's your  
14 recommendation to the agency?

15 Dr. Heeringa?

16 DR. HEERINGA: Here again, I have no expertise on  
17 the specific value, but I think ultimately we're going to come  
18 forward, at least some of us, with a recommendation for simulation  
19 over reasonable ranges of these. And if difference is between 3.2  
20 and 6.8, I think that's a reasonable range with which to simulate  
21 uncertainty in these parameters, and even zero to 6.8 percent is

1       probably reasonable range.

2                       DR. ROBERTS: Any other comments?

3                       Dr. Vu, I'm not sure we have given you a real clear  
4       feedback on this particular issue.

5                       DR. VU: Well, thank you, Dr. Roberts.

6                       I'm hearing a different viewpoint among the panel  
7       members. Some recommendation to look at a range. That means  
8       we need to conduct probabilistic risk assessment. And others  
9       would say go to the Superfund number, which is 3 percent. So the  
10      agency would prefer to have a consensus, but if not, the agency  
11      will take whatever the recommendation you come up with and we'll  
12      live with whatever you come up with.

13                      DR. ROBERTS: Thank you, Dr. Gordon.

14                      Are you going to make a last ditch attempt at a  
15      consensus?

16                      DR. GORDON: A few percent seems reasonable, but it  
17      should be corrected for behavior and time of exposure, just like  
18      oral or any other route of exposure, not just -- don't take a 24-hour  
19      value.

20                      DR. ROBERTS: Any other comments?

21                      Dr. Kissel?

1 DR. KISSEL: Sorry, but I probably should say one  
2 more thing. I was just handed the Raman (ph) and Hughes sodium  
3 arsenate study which is not referenced in the EPA list. They've  
4 got the Duckawitz (ph) paper in there, which was a rat tail  
5 absorption thing.

6 This one shows much higher absorption from water  
7 than the Wester results.

8 The soil numbers are lower and the water number is  
9 much higher. And it may have to do with speciation. This is  
10 sodium arsenate instead of arsenic acid, and arsenic acid may just  
11 stay in the water and arsenate and sodium arsenate may partition.  
12 I don't know.

13 But I think we're in trouble on guessing a number for  
14 the dislodgeable residue. I don't have any -- I think the numbers  
15 here are high for soil, and so we're safe on that one, but I don't  
16 know what the number should be for dislodgeable residue.

17 DR. ROBERTS: I think there is probably -- I think  
18 there is agreement that the panel is a little uncomfortable about  
19 making a recommendation on dislodgeable material because there  
20 is very little to go on.

21 Any further comments on this question?

1                   It's 11:00 in the morning and we have finished question  
2   number 3.

3                   Let's take a 15-minute break and regroup and begin  
4   question number 4.

5                   (A recess was taken.)

6                   DR. ROBERTS: To the panelists, the ones we have  
7   present, please let me repeat my mantra, which is, keep your  
8   responses as short and to the point as possible so we can move our  
9   discussion forward.

10                  We are beginning question 4. That means we have, if  
11   my math is correct, 12 questions to address.

12                  Let me also point out that this is the last day of this  
13   meeting, and we'll go as long as we have to go to get through our  
14   business. I suppose, technically, we have to quit at midnight, but  
15   hopefully it won't come down to that.

16                  Dr. McMahon, would you please pose question 4 to the  
17   panel.

18                  DR. McMAHON: Yes. Thank you, again, Dr. Roberts.

19                  Our question number 4 relates to inorganic chromium  
20   in CCA-treated wood and the selection of the hazard database.

21                  Our question reads: As the available monitoring does



1 not differentiate among chromium species found in CCA  
2 dislodgeable residues on wood surfaces and in soils -- although, to  
3 qualify that, I think we saw some data yesterday from  
4 Dr. Townsend that updated us -- and as Chromium 6 is the more  
5 toxic species of chromium, please comment on whether the use of  
6 the hazard data for Chromium 6 is the best choice for  
7 characterizing hazard and risk from exposure to chromium as a  
8 component of CCA-treated wood. Please provide a scientific  
9 explanation and justification for your recommendation on the  
10 choice of either the Chromium 3 or Chromium 6 hazard database.

11 DR. ROBERTS: Dr. Chou, would you lead off our  
12 discussion -- Dr. Mushak has agreed to --

13 DR. MUSHAK: We caucused yesterday in the interest  
14 of time and agreed that -- and it was unanimous; it wasn't two to  
15 one -- we agreed that I would present for all three of us.

16 DR. ROBERTS: Okay.

17 DR. MUSHAK: We are in general agreement that,  
18 number one, available data from published material do not permit  
19 us to conclude that hexavalent chromium is or is not present in  
20 dislodgeable residues. And, two, available data do exist to show  
21 that when trivalent chromium species enter soils, Chromium 6 can

1 be formed and also can persist to some extent.

2 With regard to part 1, we should keep in mind that no  
3 one has shown conclusively that chromium valency in dislodgeable  
4 residues is identical to intact fixation structures; that is, evidence  
5 for or speculations about trivalency as an obligatory result of the  
6 very process of fixation may very well not carry over when treated  
7 wood surfaces begin to deteriorate and leach chromium, arsenic  
8 and copper.

9 One should be mindful of Stan LeBeaux's (ph) caveat  
10 in his 1996 review on page 18 where he noted that if Chromium 6  
11 actually existed in these weathered surface residues, their high  
12 solubility and subsequent mobility would remove them rapidly in  
13 rain events while trivalent chromium would be more apt to stay  
14 put.

15 We would view this potential for selective removal  
16 through mobility differences being a case of, again, absence of  
17 evidence is not evidence of absence.

18 With regard to behavior of chromium as to valency in  
19 receiving soils, evidence for conversion of trivalent chromium to  
20 Chromium 6, once present in soil, is of two types, and I have some  
21 information that EPA will be circulating from peer-reviewed

1 published studies in EHP.

2                   Peer-reviewed published studies of oxidation of  
3 trivalent chromium to Chromium 6 by natural moistured soils of  
4 non-acid pH by Richards and Bartlett in several papers published  
5 in J. Environmental Quality -- Bartlett and James, JEQ, 1984, and  
6 another one in 1979 -- show that Chromium 6 is generated from  
7 Chromium 3 via the redox coupling with manganese oxide. This  
8 applies for certain native soils.

9                   Bartlett also discussed the ability of Chromium 6 over  
10 time, once formed, if the absorption of Chromium 6 to certain  
11 lignins occurs.

12                  Before these studies, it was assumed, based on soils  
13 brought into the laboratory with various alterations to their  
14 natural state, that trivalent chromium was formed.

15                  A second line of evidence is data from -- our data from  
16 studies disposal of chromite residues through sites in Hudson  
17 County, New Jersey. One of the reports of these residues is that of  
18 Burke and coworkers published in EHP from a chromium  
19 conference who showed that hexavalent chromium in soils with  
20 these residues, when mixed with soils, was present over a wide  
21 hexavalent chromium range of 1 to 50 percent.

1                   Given that we can't rule out Chromium 6 on surfaces of  
2           treated wood and that Chromium 6 can be formed and be stable in  
3           certain soils, it is scientifically reasonable to employ the  
4           hexavalent database.

5                   DR. ROBERTS: Thank you. And, Dr. Mushak, let me  
6           be clear. That represents the joint input from the three  
7           discussants?

8                   DR. MUSHAK: Right. Although they didn't sign any  
9           contracts.

10                  DR. ROBERTS: I understand, but let me congratulate  
11          the three of you for very efficient presentation.

12                  Dr. Morry?

13                  DR. MORRY: Yes. That statement does represent a  
14          consensus of the three of us, but I would like to add just a couple  
15          of comments to that.

16                  Obviously, this question could be answered by getting  
17          more data, by taking samples of dislodgeable chromium from the  
18          swing sets and speciating whether it's chrome 3 or chrome 6. And  
19          the same with soils. You could take samples and speciate.

20                  That hasn't been done yet. And in the absence of that, I  
21          guess we have to use the precautionary principle that Dr. Mushak

1 just described.

2                   Also, in the absence of data, there is always a lot of  
3 arguments based on chemistry where people say, well, based on my  
4 knowledge of chemistry, it should be all chrome 3 or it should be  
5 all chrome 6. And we've had a lot of experience with that in  
6 California when we were trying to set regulations for -- or do risk  
7 assessment for chromium in drinking water. We got a lot of advice  
8 from the published literature and from chemists who appeared in  
9 person and told us that chromium in the environment would never  
10 be chrome 6; it would always be chrome 3 based on chemistry  
11 arguments.

12                   So I became very suspicious of that because, after we  
13 did a risk assessment and made an assumption about what  
14 percentage would be chrome 6, people actually went out and  
15 started taking samples and analyzing them and speciating them,  
16 and we found a lot more hex-chrome than we expected to find.  
17 We had drinking water samples where 80 percent or so of the  
18 chromium in the drinking water is hex-chrome, which chemists  
19 told us could not be possible.

20                   And we've also found hex-chrome in air samples and  
21 soil samples that we speciated.

1                   So based on that experience, I think that reinforces the  
2 precautionary principle of, in the absence of actual speciation,  
3 assume that all or most of it is hex-chrome where there is  
4 chromium present.

5                   DR. ROBERTS: Great.

6                   Dr. Chou; then Dr. Shi.

7                   DR. CHOU: I want to say one more time we do have  
8 consensus in overall decision. A couple of things I want to add to  
9 indicate how difficult it is to theoretically decide how much is  
10 Chromium 6 or Chromium 3.

11                   Another condition is the two different chromium  
12 valencies also preferentially accumulates in different kinds of  
13 soil. For example, Chromium 6 tends to accumulate in clay more  
14 than sandy soil. And we also know how much acidity we have what  
15 and kind of soil we're dealing with.

16                   Another reason we decided to do this -- make a very  
17 conservative decision is even when we do have soil samples  
18 analyzed, even from the same source, if you assume exactly the  
19 same soil, the result coming from different laboratories can vary  
20 quite's bit.

21                   So, basically, there are some data out there. Even that,

1 we don't know how reliable they are.

2 DR. ROBERTS: Thank you, Dr. Chou.

3 Dr. Lees actually had his hand up a little while ago.

4 Let me take Dr. Lees' comment, then Dr. Shi, then Dr. Freeman.

5 DR. LEES: I think given the acknowledged huge  
6 difference in the toxicity data between chrome 3 and chrome 6,  
7 this is really a very, very important question to be answered.

8 My personal suspicion and at least some of the data  
9 indicate that the vast majority of chromium is present in the plus  
10 3, the trivalent form. There certainly is indication of some  
11 hexavalent, and I certainly can't preclude -- and I certainly can't  
12 quantify the amount of chrome 6 in these different potential  
13 exposure sources.

14 And I think, given this uncertainty and the huge  
15 implications for the risk analysis, what we assume this chromium  
16 to be, some real exposure information is important. And to that  
17 end, the EPA CPSC playground study that we heard described -- it  
18 seems like 200 years ago, but I guess it was Tuesday -- I think it  
19 should provide, you know, crucial information to this decision.

20 Having said that, I need to point out that what is  
21 proposed in the EPA CPSC study is just a measure of total

1 chromium and that's just not going to give you the important  
2 information that you need to make this decision.

3 And, again, given the huge difference in the toxicities,  
4 the assumption has huge implications on the bottom line.

5 DR. ROBERTS: So your recommendation would be to  
6 collect empirical data on chromium speciation as part of that  
7 effort to -- strong recommendation that --

8 DR. LEES: Very hugely strong.

9 DR. ROBERTS: I think they had proposed to do a  
10 pilot, but I'm sensing you would suggest they do more than do a  
11 pilot; they should make that part of the study.

12 DR. LEES: Exactly.

13 DR. ROBERTS: Dr. Shi and then Dr. Freeman.

14 DR. SHI:

15 From NIOSH. I just wanted to make a comment  
16 concerning the difference between Chromium 6 and Chromium 3.

17 The bigger difference is Chromium 6 can enter into the  
18 cell, but the Chromium 3 does not.

19 But when the chromium enters into the cell, you can  
20 reduce to Chromium 3. But whether the Chromium 3 is inside the  
21 cell or the Chromium 3 is outside of the cell makes a big



1 difference.

2                   For example, in some report -- EPA report, they said  
3 because Chromium 6 always reduces to Chromium 3 very rapidly,  
4 by ascorbic or some other reductant, it is therefore -- after a while,  
5 Chromium 3 and Chromium 6 may be different. It's not, because  
6 even though they can be reduced to Chromium 3, that Chromium 3  
7 produced is inside the cell, not like the regular Chromium 3 that  
8 cannot enter the cell. This is the first difference.

9                   Secondly, when the chromium is reduced to  
10 Chromium 3, you can reduce first to Chromium 5 and the second to  
11 Chromium 4. And the Chromium 5 and the Chromium 4 can  
12 produce a huge amount of hydroxyl radicals.

13                  During the production of hydroxyl radicals,  
14 Chromium 5 and Chromium 4 go back to Chromium 6 again, so  
15 they can have some circle of the reaction.

16                  So a small amount of Chromium 6 can produce a big  
17 amount of hydroxyl radicals.

18                  And it's very hard to judge how much is Chromium 6  
19 and how much is Chromium 3 because the Chromium 3 can react  
20 with hydrogen peroxide and with other species -- also produce  
21 Chromium 4 and eventually Chromium 6. And that's a different

1 condition.

2 For example, if the water have algae or some plant  
3 other reductants, it can be quite different.

4 So even though you know this is Chromium 6 or the  
5 ratio of Chromium 6 and Chromium 3, but it would only be in  
6 certain particular situation because it's just a change according to  
7 the condition.

8 In the laboratory, Chromium 6 can cause DNA damage  
9 and it can cause protein mortification, apeidosis, cause gene  
10 suppression. These are all results coming from my laboratory.

11 We have about 40 or 60 papers concerning the  
12 difference between Chromium 6 and Chromium 3. And OSHA tried  
13 to regulate the occupational standard of Chromium 6 and  
14 Chromium 3. They fund my research in an amount of about  
15 \$100,000 a year since 1997 just to study the difference between  
16 Chromium 3 and Chromium 6.

17 And the Chromium 6 effect most likely is a free radical  
18 effect because all the reactions we saw can be inhibited by  
19 antioxidants. So Chromium 6 is much more toxic, is much more  
20 carcinogenic. This is the first.

21 Second --

1 DR. ROBERTS: Dr. Shi, I don't mean to cut you off.

2 But is this leading to your answer on this particular question?

3 DR. SHI: I'll be finished just in one minute.

4 DR. ROBERTS: Okay.

5 DR. SHI: And the second is you don't know how much  
6 of Chromium 6 enters Chromium 3.

7 So I think to use Chromium 6 as a kind of judgment is  
8 much better than Chromium 3.

9 DR. ROBERTS: Thank you very much.

10 Dr. Freeman?

11 DR. FREEMAN: I would like to approach this from  
12 several different points of view. One, I think I agree with Dr. Lees  
13 that what we really need is to have some speciation done for the  
14 soils and the residues on these specific types of sites.

15 Some of the data that was presented yesterday by  
16 Dr. Townsend suggested that chrome 6 really is not an issue at  
17 these sites. And I say this because one of the things about Hudson  
18 County where we have done a number of studies is -- and, of  
19 course, you have to qualify this by the type of water and the type  
20 of soil that we have in Hudson County. But the stuff migrates  
21 across the surface.

1                   Chrome 6 in Hudson County -- the New Jersey  
2   Department of Environmental Protection has data at surface and  
3   different depth levels which characterizes the amount of chrome 6.  
4   There are places where it was in the percent levels, usually about  
5   10 percent. Where it was much higher than that, this was usually  
6   on the surface where the chrome 6 was in solution and when soil  
7   would dry, the stuff would crystallize and form chrome blooms.  
8   And then you get your 50 percents.

9                   I have heard nothing that suggests that we're seeing  
10   little yellow crystals when the soils dry out around these things,  
11   nor have I seen any of the data that suggests that the chrome you  
12   are seeing isn't right at the drip line and that it does not seem to  
13   have migrated in the soils. However, the soils in Florida are  
14   different. You may not have -- the pH of the water may be  
15   different. So there are lots of different things to look at.

16                  The thing about the Hudson County situation, which is  
17   basically 170 chromium slag sites -- very different conditions -- is  
18   that we also did biomonitoring of people and environmental  
19   exposures.

20                  And the only thing that we could find among children,  
21   even though we observed these kids playing on the waste sites,

1       were slight elevations in urine chromium, which we could not  
2       attribute to chrome 6, but perhaps to total chromium in their  
3       environment.

4                       So we weren't seeing any health outcomes that were  
5       indicative of the types of things that you would expect if there was  
6       a severe exposure.

7                       We interviewed people about skin rashes, and while we  
8       found some people who said they had itchy skin, when the  
9       physicians examined them, we never saw any sort of dermatitis or  
10      skin irritations or anything else that could be attributed to a  
11      chrome 6 type exposure.

12                      There was only one case with a child where there was  
13      any indication of an exposure. And this was a child who played on  
14      a chrome waste site and played marbles by pushing the marbles  
15      with his nose, and he irritation of the nasal septum. When he was  
16      removed from that -- and I think that was an inhalation exposure.  
17      Atypical. We sampled hundreds of kids; hundreds of families, in  
18      fact, and essentially under these conditions where we knew that  
19      there was high levels of chrome 6. We just didn't find things.

20                      So I would say that this may not be an issue, but I  
21      would urge that more speciation be done.

1 DR. ROBERTS: Thank you, Dr. Freeman.

2 DR. MUSHAK: If I might respond. I think you are  
3 scrambling tox issues and environmental distribution of valencies,  
4 et cetera. I think if we retreat back to the valency in the  
5 environmental media relevant to CCA, I think Bartlett's data,  
6 Richards and Bartlett's data -- one of the papers for which I'm  
7 having distributed -- indicates that, in fact, soil types are critical  
8 for 6 versus 3.

9 And having gone through the graduate school system at  
10 the University of Florida, I could tell you that the media down  
11 there in terms of acidity versus alkalinity would favor trivalency.  
12 I'm surprised that there is as much hexavalency as there is.

13 And Bartlett did address the issue of whether you have  
14 such an artifactual situation in Hudson County that what you have  
15 are these high process flags that are so alkaline that they  
16 essentially have micro-environments for preserving Chromium 6.

17 But he argued in that -- and you can read the paper and  
18 form your own conclusion -- that, in fact, there is enough mixing  
19 with soil, presumably, for the issue of valency that soil is able to  
20 intrude and preserve the hexavalency.

21 The tox issue as whether we should use a database

1       because the tox says something -- you know, that wasn't our  
2       charge. I think that's a policy call or a question call from EPA and  
3       the chairman.

4                     DR. ROBERTS: Let me dare to suggest at this point  
5       that the panel might endorse Dr. Lees' recommendation that  
6       speciation data be collected from these sites because I think that  
7       can resolve a lot of uncertainty about what the actual conditions  
8       are.

9                     DR. MUSHAK: I would agree. In fact, I would argue  
10      that probably you ought to speciate all of it because one of the  
11      things about prematurity of this conference that struck me was that  
12      the chromium valency issue is best determined for the nation as a  
13      whole by these proposed studies. So we're kind of looking at an  
14      interim selection of what we think are mixtures of hexavalent and  
15      trivalent.

16                    When we know the protocols, if they are expanded to  
17      include speciation across the board, that would probably answer  
18      exactly that.

19                    DR. ROBERTS: Dr. Morry, Dr. Gordon and  
20      Dr. Solo-Gabriele.

21                    DR. MORRY: Just three quick comments.

1                   Dr. Shi referred to a statement that said that chrome 6  
2   is reduced to chrome 3 in the body and that it becomes non-toxic.  
3   I have seen that statement hundreds and hundreds of times and it  
4   always refers to outside the cell. For example, when you ingest  
5   hex-chrome in drinking water or food, in your stomach it's reduced  
6   to chrome 3.

7                   So I think that's what that statement is referring to, not  
8   intra-cellular reduction.

9                   In California, we have lots of environmental problems  
10   with hex-chrome. And weekly or monthly we're finding new  
11   things. I mean, chrome can enter into the environment as trivalent  
12   or hexavalent and, in environmental situations, it can be oxidized  
13   or reduced to the other form.

14                  I believe in -- I would like to see chemistry used to  
15   understand what happened after you found out -- after you find out  
16   what happened. But not -- I don't have much confidence in it  
17   anymore in predicting what will happen beforehand. So I think  
18   you have to take samples on every kind of soil or medium that you  
19   are concerned about.

20                  In taking soil samples, speciation is -- speciating those  
21   for chrome 3 or chrome 6 is important. It's also important exactly



1 where you take the soil sample. You cab -- if you are two inches  
2 off, you can miss it. But it will be there.

3 So you have to be very careful about where you take  
4 those samples. Try to get them where the chromium is dripping  
5 onto the ground.

6 DR. ROBERTS: Thank you.

7 Dr. Shi, did you want to respond? I don't want to get  
8 sort of into --

9 DR. SHI: Just very short. I said Chromium 6 reduced  
10 to Chromium 3. I want to emphasize that this is not a  
11 detoxification process because, first, Chromium 3 cannot enter a  
12 cell. When the Chromium 6 is reduced to 3, this happens inside of  
13 the cell. And Chromium 3 inside the cell can bind to DNA.  
14 Chromium 3 out of the cell cannot.

15 So even though it can be reduced to Chromium 3, it's  
16 not a detoxification pathway. This is a first.

17 Second, in the reduction process, free radicals are  
18 produced. Also the free radicals can cause DNA damage and also  
19 cause a problem.

20 So Chromium 6 reduced to Chromium 3, not toxic.  
21 This is not a detoxification pathway.

1 DR. ROBERTS: Dr. Gordon?

2 And let me -- before you comment, let me say that I'm  
3 not hearing a lot of disagreement on the response to this question.

4 I've been hearing a lot of points, but I'm not hearing a  
5 lot of disagreement. So there is -- I was getting ready to ask you if  
6 you could see if you could capture what's going on as part of your  
7 comments and put us all on the same track.

8 DR. GORDON: No, I was going to disagree.

9 DR. ROBERTS: Oh, you are going to disagree. Okay.  
10 Well, feel free to do so.

11 DR. GORDON: While I agree that the hexavalent is the  
12 risk from CCA wood, soil or dislodged whatever, I don't think we  
13 can -- if we are being asked to assume that it's 100 percent, that all  
14 the chromium that's measured, all the data we have so far, it's 100  
15 percent 6, then I disagree with that because I think even the  
16 minuscule data for Florida soils maybe that Stilwell and Townsend  
17 gave yesterday -- I mean, I think they said it was either  
18 undetectable and maybe a high value of 5 percent.

19 And given the fact that the CCA wood, if properly  
20 fixed -- hopefully if it's fixed, completely fixed -- that it's going  
21 to be up in the high 90s that, yes, that's reasonable. And I don't

1 think we should assume it's 100 percent 6 if, in actuality, it's  
2 probably in the high 90s of Chromium 3 and we have a paucity of  
3 measurements that say, yes, that's a reasonable --

4 DR. MUSHAK: If I might respond to the --

5 DR. ROBERTS: Dr. Mushak, I have a couple more  
6 people, and I'll put you down on the list. But I think Dr. Gordon  
7 has sort of put out on the table for discussion -- he doesn't object  
8 to Chromium 6, but he thinks that perhaps some sort of a default  
9 assumption or a generalizing assumption in lieu of the data that  
10 we're going to strongly recommend be obtained -- in lieu of that,  
11 that perhaps some adjustment on the total chrome concentrations  
12 would be in order?

13 DR. GORDON: I agree. That's my point.

14 DR. ROBERTS: Okay. Dr. Chou and then  
15 Dr. Solo-Gabriele, then Dr. Mushak.

16 DR. CHOU: It is true in the natural environment we  
17 will never find 100 percent Chromium 6. I agree with that. And  
18 we interpret the question as either Chromium 3 or Chromium 6  
19 would be the choice of the decision.

20 But if we're going entertain the thought of doing a  
21 fraction -- we tried that thought -- it's getting difficult. It

1       probably will go very high, I would think at least about 50 percent  
2       to cover the known possibility already. Maybe even higher.

3                       So I guess we could talk about.

4                       DR. ROBERTS: That's good. Dr. Chou has put a  
5       number out there.

6                       Dr. Solo-Gabriele?

7                       DR. SOLO-GABRIELE: I see the chromium issue in  
8       two places. One is with the fixation process.

9                       Chromium converts from 6 to 3. And probably by the  
10      time a playground is built, there has been enough time elapsed that  
11      a lot of that chromium would have been converted over to 3. So  
12      the fraction in the wood would likely be very low.

13                      Once in the wood, there is a potential for it to leach out  
14      and interact with various environmental parameters for it to  
15      potentially convert.

16                      However, the little data that we do have -- and it's very  
17      preliminary data and it's limited -- does show -- it was my  
18      interpretation of Tim Townsend's work that it's a relatively small  
19      fraction that was observed in Florida. Exactly what the fraction is  
20      I don't think we have a large-enough data set at this time to really  
21      quantify it, but I think to be very conservative, the 100 percent

1 chromium is one way to go. But once I believe data starts  
2 accumulating and you start getting more data, I believe it's going  
3 to fall. And there is going to be evidence to decrease it.

4 DR. ROBERTS: Dr. Mushak and then Dr. Lees.

5 DR. MUSHAK: Terry, keep in mind that our charge  
6 was not to dichotomize this stuff into 100 percent one or the other.  
7 It was left to us to sort of assume that if there were mixtures, then  
8 basically the default database for the more toxic component of the  
9 mixture would apply.

10 To the extent that we have, at least in some cases,  
11 non-trivial levels of hexavalent chromium, then I think it's the  
12 agency's problem to take that and adjust for how it wants to use the  
13 hexavalent database to adjust for fractions.

14 Our charge was not to adjust for fractions, even small  
15 fractions. It was basically, is it scientifically reasonable to use a  
16 hexavalent database? And we answered in the affirmative.

17 DR. ROBERTS: I believe we did. And I think -- well,  
18 what happened to the question? May I ask that we sort of keep the  
19 questions projected to sort of keep us all on the question.

20 Dr. Lees, I believe was next. And then Dr. Shi.

21 DR. LEES: Actually, this is partially in response to

1        what Dr. Mushak has to say, and Dr. Gordon.

2                        Again, going back to the huge difference in the  
3        toxicities, one is a great carcinogen; the other is an essential  
4        nutrient.

5                        I think the solution proposed by -- you know, in the  
6        absence of knowing what is actually there, and the interim working  
7        solution to assume that, based on the data, a certain percent is the  
8        more toxic hexavalent form is appropriate.

9                        I think that the caveat here is that, in the risk analysis,  
10       if you use -- whatever you use, whatever your measure is in the  
11       risk analysis, you have to use the appropriate tox data.

12                       As proposed right now, they are measuring total  
13       chromium, which, in this case, is probably predominantly 3, but  
14       applying the hexotoxicity. And I think that's a mismatch that's  
15       inappropriate.

16                       DR. ROBERTS: Dr. Vu, please help us with our  
17       discussion here.

18                       DR. VU: Thank you, Dr. Roberts. Let me try to put  
19       this in context on behalf of my colleagues here in EPA.

20                       We all recognize that the health effects of Chromium 6  
21       is more toxic than Chromium 3, as Dr. Shi says, partly because

1 Chromium 6 can enter into the body.

2 And that's where we -- and what we need to know is the  
3 chromium in the environmental setting deal with CCA-treated, is it  
4 Chromium 6 or Chromium 3? Because Chromium 6 can enter the  
5 body and Chromium 3 would not elicit a reaction if it doesn't get  
6 in.

7 Right now, the agency is assuming that we have to use  
8 a total chrome until we have better data, and I think that's why  
9 Dr. Lees strongly supports the speciation to know -- and how  
10 exactly, what is the total amount environmentally? Is it 6 or 3?  
11 Because that's the critical crux of whether we overestimate the  
12 risk if we use this assumption.

13 The agency is using a precautionary preassumption  
14 until we have a better handle on it, and I think that's where we are  
15 at this moment.

16 DR. ROBERTS: Dr. Lees can respond.

17 DR. LEES: And along that line -- I guess my bottom  
18 line is you are assuming 100 percent chrome 6.

19 In terms of conservative, it's exceedingly conservative.  
20 We've heard other numbers thrown out -- you know, maybe 57  
21 percent might be more appropriate. I think over here 5 to 10

1     percent of the total chromium could be assumed, could reasonably  
2     be assumed to be hexavalent.

3                     And I think, you know, for this first cut purpose, some  
4     assumption having to do with the total chromium, that not all of it  
5     is hexavalent and a certain percent is hexavalent might be a good  
6     interim step to take before you get the actual data.

7                     I personally think, from having analyzed such samples  
8     myself, that if you were to -- something in the order of, if you  
9     were to assume that 10 percent of the chromium was hexavalent,  
10    that is probably a very, very, very conservative measure. I suspect  
11    it's actually well less than that.

12                    DR. ROBERTS: So it appears from several of the  
13    points that have been raised that the panel seems to be  
14    recommending that the agency not assume that all of the total  
15    chromium is hexavalent; that they perhaps should make some  
16    adjustment.

17                    I don't know if we want to give a number, but maybe we  
18    should -- we can, if we think we can come up with one. If we can't,  
19    we can just tell the agency that we think that they ought to review  
20    the best available data they can find and factor that into their  
21    assumption on chromium.



1                   Would that be adequate for the panel, or is there a  
2     sense that you want to recommend a specific value?

3                   Dr. Mushak?

4                   DR. MUSHAK: I have no problem with a range, but I  
5     do have a problem with hitting a number that, given the  
6     consequences for public health -- Dr. Lees, you talk about really  
7     impacting the bottom line. Is this an economic bottom line or is  
8     this a public health bottom line?

9                   If it's a public health bottom line, then I think a lot of  
10    due deference in the uncertainty should be given to worst case  
11    scenarios.

12                  I'm troubled by a 50 percent -- realizing, of course,  
13    that if we use the Hudson County data as sort of a worst case for  
14    all hexavalency in soils, then nothing will ever be above 50  
15    percent -- well, that's one issue. I mean, I think we can quickly  
16    discuss that.

17                  But taking a range that may be 50 -- you know, 20 to  
18    50, 50 to some unknown higher number less than 100 percent may  
19    be --

20                  DR. ROBERTS: And let me propose that -- again, this  
21    is a good reason not for us to spend a lot of time coming up with a

1 number because I think we could spend a lot of time and still not  
2 come up with an agreement. But we can certainly communicate to  
3 the agency that, in selecting that percentage, they consider a wide  
4 range of possible scenarios and that, in the interest of coming up  
5 with a protective value, that they pick a percentage that would be  
6 at the upper end of what might be encountered in these kinds of  
7 situations using the best available information. That kind of a  
8 recommendation.

9 Is that a recommendation that the panel could endorse?

10 Does anyone want to dissent or offer a different  
11 recommendation?

12 DR. CHOU: I would agree, this is a ver good approach.

13 DR. ROBERTS: Dr. Shi.

14 DR. SHI: I just want to add a little bit of comments.

15 For the issue of Chromium 3 and Chromium 6 in a soil,  
16 you cannot process really because the Chromium 3 go to  
17 Chromium 6 depends on pH, depends on the sunlight. UV also  
18 plays a very important role.

19 Now, the moisture, the water, it's just realistic to  
20 measure exactly what's at issue for the question of the matter --  
21 and if we decide whether the issue should be Chromium 6 or

1 Chromium 3 used as the standard, I think Chromium 3 is the better  
2 choice. I do not think to get 50 percent or 40 percent or 10 percent  
3 is what we want right now. I think that Dr. Mushak uses that as an  
4 indicator. I think that's a good one.

5 DR. ROBERTS: Dr. Lees.

6 DR. LEES: I would support absolutely from the public  
7 health protection the use of a worst case, but I would interject one  
8 word. A reasonable worst case.

9 DR. ROBERTS: That's fine.

10 Dr. Vu, have we come to some clarity in our feedback  
11 to you?

12 DR. VU: I think the agency is very pleased to hear that  
13 recommendation. Thank you.

14 DR. ROBERTS: Let's go ahead then, and, with that,  
15 unless I hear objection from the panel, let's proceed to question 5.

16 DR. McMAHON: Question 5 relates to the short and  
17 intermediate-term endpoint selection for inorganic chromium.

18 The question to the panel is to please comment on the  
19 agency's selection of the 0.5 milligrams per kilogram per day  
20 NOAEL value for use in assessing risks to the general population  
21 as well as children from short-term and intermediate-term

1 incidental oral exposures to inorganic chromium as contained in  
2 CCA-treated wood.

3 Please provide an explanation and scientific  
4 justification for your conclusions as to whether the presented data  
5 are adequate or whether other data should be considered for  
6 selection of these endpoints.

7 DR. ROBERTS: Dr. Lees, I have you down as first off  
8 on this one. Would you start the discussion.

9 DR. LEES: I'd be happy to. I'll try to be as concise as  
10 possible, and I had two major points that I wanted to make.

11 Essentially, we covered the first point in the preceding  
12 discussion. So I would like to proceed directly to the question of  
13 this .5 milligram per kilogram per day NOAEL and the evidence  
14 that -- you know, the study that was used to support that.

15 First of all, this should be an interesting presentation  
16 because essentially this is a non toxicologist reviewing a tox  
17 study, so bear with me.

18 The study that has been used by the agency for the  
19 purpose of the NOAEL for the short and the intermediate term oral  
20 exposure is actually the same study that they used for the  
21 assessment of the reproductive developmental risks; that is, the

1 study by Tyl, I think it's 1991.

2 And just very, very briefly, this is a study of rabbits in  
3 which they were exposed to chromic acid via a bolus of -- by  
4 gavage, a bolus of essentially chromic acid.

5 And these were pregnant rabbits, as I said. That was  
6 the primary purpose, was to look at the developmental things.

7 In any event, there was a series of -- a dose range, the  
8 highest dose of five milligrams per kilogram per day. This  
9 involved -- as I said, these were chromic acid in distilled water, so  
10 it wasn't buffered at all.

11 And the resulting material that was gavaged had a pH  
12 of 1.5 in the highest dose. This continued -- I think it was a 12 day  
13 dosing regime.

14 The effects that were noted in the two high dose were,  
15 first of all, mortality. And, in the highest dose, reduced weight  
16 gain. The highest dose, diarrhea and labored breathing I think was  
17 the other thing that was mentioned.

18 There was no pathology. You know, the animals were  
19 autopsied at the end of the thing and there was no pathology noted  
20 in any of these animals.

21 Again, as a non-toxicologist here, I have great

1 difficulty differentiating or attributing, if you will, the effects  
2 noted here to chromium as opposed to just the plain old acid  
3 effect. And I would defer to my toxicology colleagues on the  
4 panel. But -- you know, I guess I wouldn't be surprised if this  
5 were -- well, we'll have a discussion on whether this is chromium  
6 effect or an acid effect.

7           Having said that, there is a supporting study that is  
8 cited by the agency, one of -- from China by Chiang (ph) and  
9 Lee -- which there is a population that was exposed to drinking  
10 water that had a chromium concentration, and it's not really clear  
11 whether it was hexavalent or trivalent or some mixture, of 20  
12 milligrams per liter. The suggestion is that it's hexavalent.

13           And in this case, the exposure or the dose would be on  
14 the order of about .6 milligrams per kilogram per day.

15           And that were -- the effects that were noted there were  
16 sores in the mouth, digestive -- you know, vomiting, diarrhea, and  
17 those kinds of things for the most part.

18           So I guess the bottom line is that the Tyl study, the  
19 main one that's cited to substantiate this .5 level, I have serious  
20 questions about whether it demonstrates what they actually say it  
21 demonstrates.

1 DR. ROBERTS: Okay. So --

2 DR. LEES: I guess maybe we should first have a  
3 discussion whether it does demonstrate what it --

4 DR. ROBERTS: Fair enough. And then maybe we can  
5 decide.

6 DR. LEES: And if it does not, as I suspect, then there  
7 has to be -- and I'm not familiar with the animal literature, but it  
8 seems to me there has to be some more appropriate -- you know,  
9 instead of this bolus gavage, some dietary study or something like  
10 that that might be more appropriately used to establish this value.

11 (Thereupon, Volume I of II was concluded.)

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FRANCES M. FREEMAN



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8 703/723-3550

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10 TODAY'S DATE: 11/20/01

11

12 DATE TAKEN: 10/25/01

13

14 CASE NAME: FIFRA 3rd day

15

16 DEPONENTS:

17

18 **TOTAL: -- PAGES:** 193 pgs

19

20 ATTORNEY TAKING DEPO:

21

22 COPY SALES To:

23

24 DELIVERY: 10

25

26 COMPRESSED:

27

28 DISK:

29

30 E-MAIL:

31

32 EXHIBITS:

33

34 TRIAL DATE:

35

36 \*\*SIGNATURE: n/a